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UNITED STATES DEPARTMENT OF AGRICULTURE

DEPARTMENT BULLETIN No. 1345

Washington, D. C. ▼ October, 1925

SALTBUSHES AND THEIR ALLIES IN THE UNITED STATES

By

G. L. BIDWELL, Bureau of Chemistry, and E. O. WOOTON, formerly of the Bureau of Plant Industry

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By G. L. Bidwell,[1] *Bureau of Chemistry*, and E. O. Wooton,[2] *formerly of the Bureau of Plant Industry*[3]

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INTRODUCTION

Covering many millions of acres of the arid and semiarid Western States are various native plants, upon which millions of meat animals graze each year. Comparatively little has been ascertained concerning the forage value of these plants, which are practically the only forage plants that grow on the dry lands, and the available data are widely scattered in bulletins and reports. A study of these plants was therefore begun several years ago by the Bureau of Chemistry and the Bureau of Plant Industry of the Department of Agriculture.

The information thus obtained on certain of the native grasses that are extensively used as range forage plants was published in 1915 as Department of Agriculture Bulletin 201. Similar data on some of the saltbushes and a few of their allies are presented in the following pages.

The term saltbush has very properly been given to the group which contains the most species, as well as the largest number of individuals, nearly all of which have a pronounced salty taste. The individuals classed as saltbushes in this bulletin belong to the botanical genus Atriplex,[4] although certain species of this genus are known by various other common names. For instance, some of the shrubby species are called saltsage, shadscale, sagebrush, etc., while the one growing along the southern boundary of the United

[1] Assisted by C. E. Goodrich and J. B. Reed, of the Bureau of Chemistry.

[2] Now in the Bureau of Agricultural Economics.

[3] The work was instituted by David Griffiths, of the Bureau of Plant Industry. P. C. Standley, of the Smithsonian Institution, reviewed the botanical work and identified most of the species.

[4] The genus Atriplex has more than 100 species in North America.

43860°—25——1

States is known as chamizo or some contraction of this Mexican name. The term sagebrush is more properly applied to species of the genus Artemisia, the leaves of which are invariably strongly aromatic and rarely if ever salty. The saltbushes lack the strong pungent odor but have the salty taste.

The plants discussed in this bulletin were obtained by David Griffiths and E. O. Wooton, of the Bureau of Plant Industry, who prepared the descriptions of the various species. For convenience of reference the information on each plant species is given under the botanical name of that species. These names are arranged in alphabetical order under their natural plant families. Many of these plants have not yet received common or vernacular names; some widely distributed species have two or more common names, which are used in different parts of the areas where they grow. Whenever common names are known, they are used in describing the species, and a list of these names, with their scientific equivalents, is given on page 37. It is hoped that the nontechnical descriptions, supplemented by the illustrations, will enable interested laymen to identify the different plants.

Many of the plants were analyzed in the Bureau of Chemistry, according to the methods of the Association of Official Agricultural Chemists. The letter "G" in parentheses after the department sample number indicates that the material was collected by Griffiths; the letter "W," that it was collected by Wooton. Specimens of all of the species analyzed in the department have been preserved, so that all the samples here reported as department samples may be readily identified. In many cases analyses made in State experiment stations have been used. Bibliographical references in parentheses indicate the source of the figures quoted. No published analyses were accepted until careful examination had shown that they were complete and correct and that they had been made on plants which could be identified. It was, of course, impossible to analyze all species of the families found in the areas covered, but the list is fairly representative of those which are most important as forage plants. These analyses are not offered as exact measures of the food value of the plants examined, as digestion coefficients have not yet been determined in all cases. They are, however, the best relative measures now available.

THE SALTBUSHES AND THEIR ALLIES

The saltbushes and their allies belong to closely related botanical groups and live in very similar places, members of different species often growing side by side over large areas. (Pls. I and II.) In most of the regions where they grow they are fairly well known under various common names (p. 37).

Some of the saltbushes are really bushes, varying in height from a foot to 10 feet. Others, like the Australian saltbush, are weedy herbaceous annuals or perennials, to which the average person would be unwilling to apply the term "bush." In general, they have thickish, mostly undivided leaves, which are nearly always grayish because of a scurfy or scaly (not hairy) covering. The leaves may be small or an inch or more long, and many of them have a cool, wet "feel." All have numerous small dull-yellow or green

flowers, of two kinds (staminate and pistillate), which many people would fail to recognize as flowers. The plants of some species bear both staminate and pistillate flowers; those of other species bear one kind only. The fruits are small, dry one-seeded pods.[5]

A number of the saltbushes and their allies now growing on the arid western ranges are weeds, accidentally introduced from the Old World, which have made themselves very much at home in their new surroundings. Several species of the Australian saltbush were intentionally introduced into western America in 1882 (*15*).[6]

The saltbushes proper, as well as their near allies, like the greasewood of the Great Basin region, the Russian thistle, the iodine-weed, the seablight, and the common lamb's-quarter or goosefoot, are closely related to the beet, chard, and spinach, and a few of the wild species are used by man as "greens." Hence it might be expected that many of them would be reasonably good forage plants wherever they grow. They are as truly forage plants in their natural distribution areas as are timothy or alfalfa in cultivated fields, and some species cover hundreds and even thousands of square miles. Furthermore, many of them grow on land and under conditions that will produce no other plants of economic value. Several grow readily in soil so alkaline as to be useless for the production of practically all cultivated and most of the other wild species, and nearly all of them are adapted to a degree of aridity too great for most of the better known forage plants. The very characteristics that make many of these plants "bad" weeds—their abundant seed production, great viability of seeds, effective methods of seed dispersal, ready adaptability to a wide variety of soils and climatic conditions; in short, their aggressive adaptability among other plants to a new country—make them "good" range plants, if they are palatable to livestock. As additional feed on areas producing other forage they are also important. It is not intended to suggest that they are always first-class stock feed, for they do not furnish excellent forage, as a general thing. Stock can and do subsist upon them, however, and every year thousands of meat animals reach the abattoirs without having had much of any other kind of feed.

Feeding experiments have shown that under certain conditions some saltbushes and allied plants may be poisonous to sheep, a very important matter to the sheepmen who use the winter ranges of the Great Basin region.

RESULTS OF EXAMINATION AND ANALYSIS

GOOSEFOOT FAMILY

ALLENROLFEA OCCIDENTALIS (S. Wats.) Kuntze

Allenrolfea occidentalis is a curious leafless bush, usually 3 to 6 feet high, the main stems of which are woody and generally grayish-white. The growing ends of the smaller stems are bluish or grayish-

[5] Technically the fruits of these plants are dry, close-fitting, one-seeded pericarps called achenes. Subtending the achene, sometimes coalescent with it, is a pair of bracts, which may be variously modified into wings, teeth, ridges, or tubercles, or may be smooth and leaflike. This achene with its bracts is referred to as a "seed pod" throughout this bulletin in order to avoid botanical technicalities that are of taxonomic value only.

[6] Italic numbers in parentheses throughout the bulletin refer to Literature Cited, p. 38.

green, cylindrical, and succulent, and seem to be jointed by constrictions at short distances along the stem. The leaves are nothing but small scales at the constrictions. The inconspicuous flowers and fruits, growing as terminal spikes, are just a little larger in diameter than the stems on which they grow, so that, being of the same color, they are rarely recognized by casual observers.

This species was described and named from specimens growing on the shores of Great Salt Lake, Utah. Although it is the only species of the genus known, it is widely distributed in strongly alkaline soils from eastern Oregon, south through Nevada and Utah, to California, Arizona, New Mexico, and western Texas, and into Mexico. It never grows on any but alkaline soils and it will endure as much soil alkalinity as almost any other land plant. In California it is frequently found on "black alkali" spots. In California it is called iodine-weed, pickle-weed, and sometimes bushy samphire (*13*), and in southern New Mexico it is called burro-weed.

Department sample 8937 (G) consists of twigs, about 6 inches long, from the ends of stems in full bloom, collected at Mecca, Calif., in the Salton Basin, September, 1907. Department sample 11107 (G) was collected at Winslow, Ariz., October, 1915, in alkali spots along the Little Colorado River.

Sample	Moisture	Composition (water-free basis)					
		Ash	Ether extract	Crude fiber	Nitrogen-free extract	Protein	Pento-sans
	Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
Department 8937 (G)	7.0	28.7	1.3	10.7	46.6	12.7	16.3
Department 11107 (G)	4.8	31.7	2.3	15.1	41.1	9.8	13.2

This species is eaten sparingly by stock when no better feed is obtainable. It usually has a very salty taste.

ATRIPLEX ACANTHICARPA (Torr.) S. Wats.

Atriplex acanthicarpa is a low, branching shrub, 18 inches to 2 feet high, with almost white, scurfy leaves and stems. The leaves are an inch long or less and half as wide, with few coarse teeth. The fruits are most characteristic, being one-seeded pods, covered by thick bracts about one-fourth of an inch long, beset with numerous blunt, stiff points, projecting in all directions. Produced in abundance on the ends of the stems, they are very noticeable.

This species, named from specimens collected on plains near the Burro Mountains of southern New Mexico, grows in alkaline soil in southern Arizona and New Mexico, as well as in western Texas, extending into northern Mexico. It often covers completely the flat bottom of a basin where flood waters and alkali collect, or appears as a strip of bushes of varying width about the edges of such playas or on the dry gravelly ridges near by.

Department sample 8560 (G) is the growth of the year only, in fruit, collected near El Paso, Tex., September 22, 1906. Department sample 8566 (G) consists of fruiting plants not yet ripe, col-

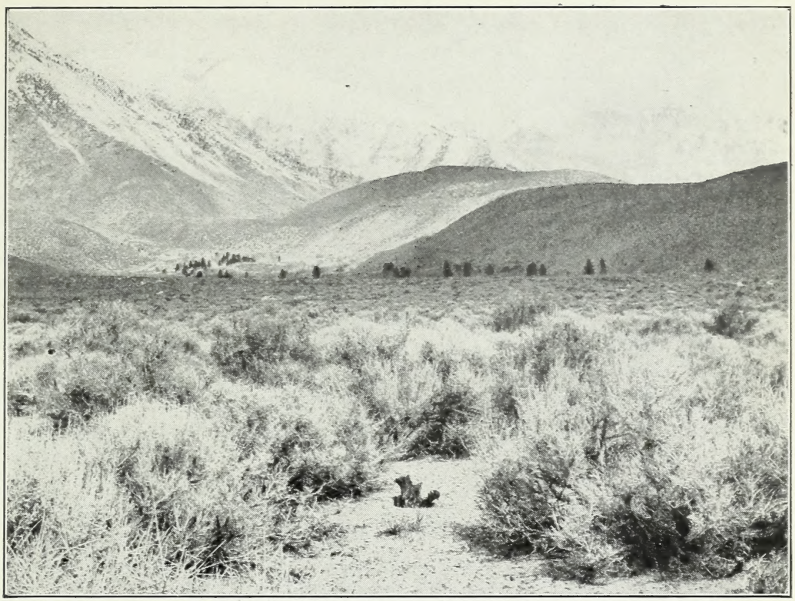

FIG. 1.—THE MIXED VEGETATION, CHIEFLY SALTBUSHES OF THREE OR FOUR SPECIES, RABBIT-BUSH, AND MORMON-TEA, GROWING ALONG THE EASTERN BASE OF THE SIERRA NEVADA, NEAR INDEPENDENCE CREEK, CALIF.

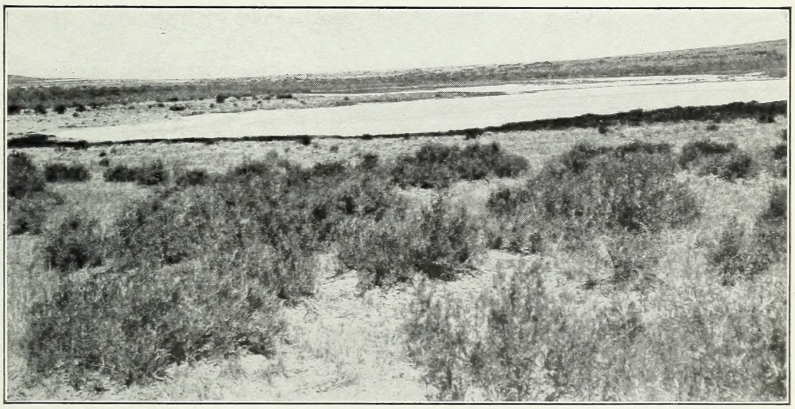

FIG. 2.—AN ALKALINE LAKE ON THE LARAMIE PLAINS, WYO., SURROUNDED BY SALTBUSHES AND THEIR ALLIES

Seablight and greasewood grow along the edge of the lake; saltsage grows in the foreground

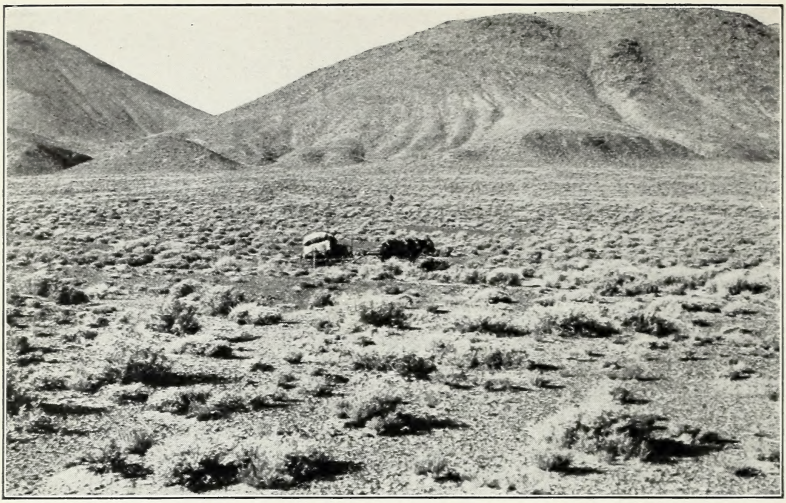

FIG. 1.—SALTBUSHES AND WHITE SAGE ON THE EDGE OF BLACK ROCK DESERT, NEV., CHARACTERISTIC OF THE VEGETATION OVER THOUSANDS OF SQUARE MILES IN THE GREAT BASIN REGION

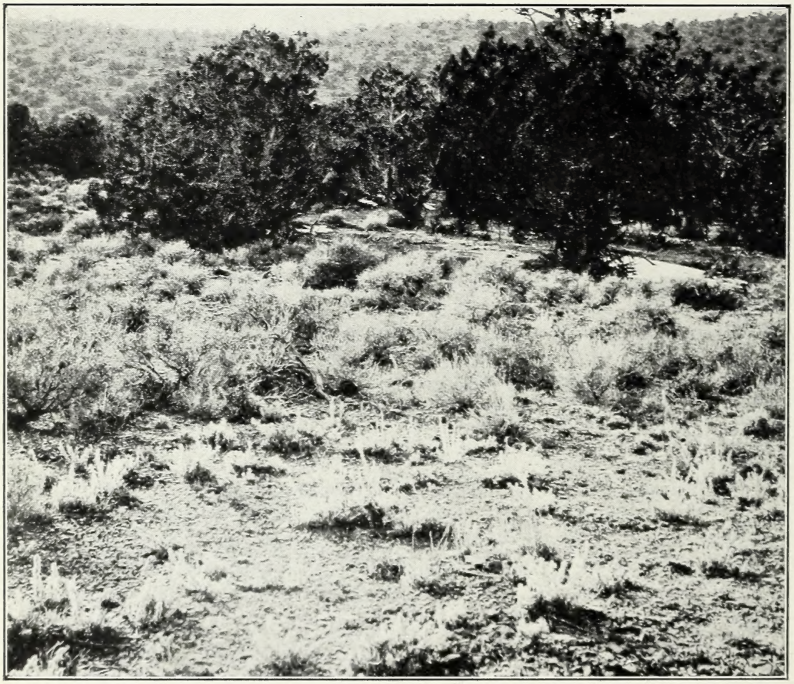

FIG. 2.—WHITE SAGE (IN THE FOREGROUND) AND OTHER SALTBUSHES GROWING AT AN ALTITUDE OF 7,000 TO 8,000 FEET IN INYO COUNTY, CALIF.

lected on the edge of an alkali flat near Lordsburg, N. Mex., September 23, 1906.

Sample	Moisture	Composition (moisture-free basis)					
		Ash	Ether extract	Crude fiber	Nitrogen-free extract	Protein	Pentosans
	Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
Department 8560 (G)	1.9	23.7	1.8	23.4	42.4	8.7	18.4
Department 8566 (G)	3.5	24.4	1.8	22.7	37.0	14.1	17.7

This species, browsed freely by cattle, is an important forage crop where it grows.

ATRIPLEX ARGENTEA Nutt.

Atriplex argentea is a typical tumbleweed, reaching a height and spread of 2 feet or more when mature. It is a leafy, branched annual. Its numerous leaves, 1 inch or 2 inches wide, are broadly oval or heart-shaped, and, like the stems, are scurfy-gray or almost silvery-white.

As individuals or in small patches, it grows, usually on the poorer soils, from the Missouri River westward through Wyoming, Montana, Colorado, Utah, and Idaho to Oregon, and south to northern Arizona and New Mexico, principally on the plains or in the valleys. It endures an excess of alkali in the soil and may be expected to put a crop of edible forage on the alkaline lands. It seeds freely and requires but a small supply of water for growth.

Sample	Moisture	Composition (water-free basis)				
		Ash	Ether extract	Crude fiber	Nitrogen-free extract	Protein
	Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
Colorado (*11*)	5.3	20.4	1.5	28.9	38.9	10.3
Wyoming (*19*)	6.2	18.5	.9	29.7	37.4	13.5

Although of itself not a good feed, this species would probably be of some value when mixed with other range plants. Extended tests on hay made from *A. volutans* A. Nels., sometimes called tumbling saltbush (*19*), using sheep, were made at the Colorado experiment station. A pronounced increase in the quantity of water used by the animals and an increased voidance of urine, with variable losses in weight, were shown.

ATRIPLEX BREWERI S. Wats.

Atriplex breweri is a shrub, 6 feet high or more, with numerous leaves, rather large for the genus, gray-green owing to their whitish mealy coating, and stems almost white when young. The small and nearly circular seed pods, without marginal teeth, are produced in large spreading clusters on the ends of the branches.

This species is native only along the southern California coast and on the adjacent islands. It has been brought into cultivation in California as a hedge plant. Its abundant foliage and rapid growth make it very productive.

Department sample 8704 (G), consisting of branches a foot long, the growth of a year, collected near Santa Barbara, Calif., September 13, 1907, contained, on an air-dry basis, 6.5 per cent of moisture, and, on a water-free basis, 22.6 per cent of ash, 2.1 per cent of ether extract, 22.4 per cent of crude fiber, 27.7 per cent of nitrogen-free extract, 25.2 per cent of protein, and 11.7 per cent of pentosans.

As a forage plant, *A. breweri* is freely browsed by range animals.

ANTRIPLEX CANESCENS (Pursh) Nutt.

Atriplex canescens (Pl. III, fig. 1) is a pale-gray shrub, from 2 to 6 feet high, branching from the ground, with gray woody main stems that are rigid and somewhat brittle, and almost white young stems, bearing narrow leaves, 1½ inches long or less, all young parts being densely white and scurfy. The small yellowish or greenish flowers, borne in panicles at the ends of the stems, are followed on the fruiting plants by conspicuous clusters of winged seed pods. The four radiating wings of the fruit are usually rather thin, yellow at maturity, one-eighth to three-eighths of an inch wide, and coarsely notched along the edges.

This species, which was named from specimens collected on the plains of the upper Missouri River near Big Bend, grows on the plains and hillsides from western South Dakota and Nebraska westward to eastern Oregon and California and south to northern Mexico. In places it forms almost pure stands over large areas, but mostly it is distributed as scattering individuals associated with other shrubs, herbs, and grass. It is rarely, if ever, found in the forested areas, although it frequently grows with scrub oak, mesquite, and catclaw in the woodland areas of the southern part of its range, especially along the arroyos or dry watercourses. As a rule, it does not grow on dry, gravelly ridges or mesas. It is tolerant of alkali in the soil, but it is by no means restricted to such soils. Although it prefers a deep sandy loam, it will grow on sandy dunes or tight soils. Under certain conditions it reproduces freely from seed and grows rapidly.

Because of its wide distribution it naturally has a number of common names. In the literature this species is sometimes called shadscale, a name that probably originated in the Great Basin region, where the name always refers to another species (*A. confertifolia*). On the plains east of the Rockies it is usually called saltbush or saltsage, names which are applied to other species as well. In New Mexico and Arizona it is usually called sagebrush if no true sagebrush is present. It also frequently bears the Mexican name chamizo, or some Americanized form of it, like chamese.

Department sample 8342 (G) consists of stems of the year, 3 to 10 inches long, from both staminate and pistillate plants just beginning to bloom, collected at Ash Fork, Ariz., May 30, 1906. Sample 7234 (W) was collected on the sandhills of the Jornada Range Reserve, N. Mex., January, 1915. Sample 7235 (W) was

FIG. 1.—VOLUNTEER GROWTH OF CHAMIZO (ATRIPLEX CANESCENS) ON LAND THAT HAD BEEN PLOWED THREE YEARS BEFORE

FIG. 2.—SHADSCALE (ATRIPLEX CONFERTIFOLIA) IN OREGON

The plants in the foreground have been closely grazed; those in the background were protected by the fence

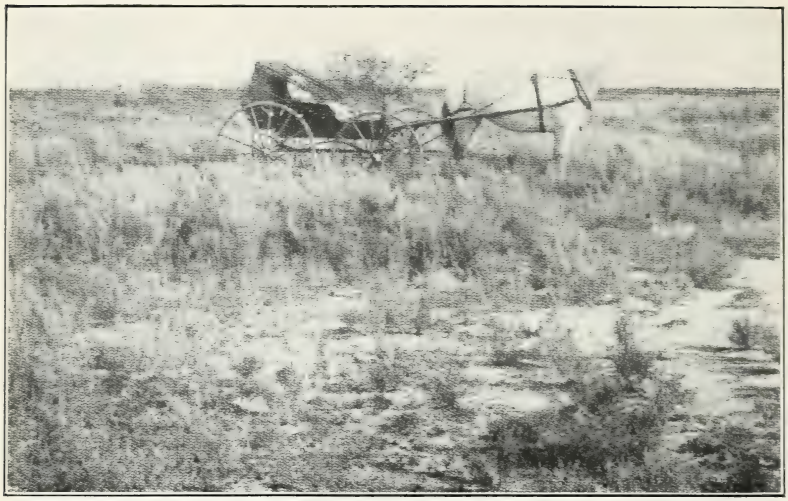

FIG. 1.—AN ANNUAL SALTBUSH (ATRIPLEX ELEGANS) ON THE MESAS NEAR TUCSON, ARIZ.

Two other species produce a similar growth in the same region

FIG. 2.—A LARGE ANNUAL SALTBUSH (ATRIPLEX HASTATA) GROWN UNDER CULTIVATION IN OREGON

It is also a widely distributed weed and forage plant in the Western States

collected near State College, N. Mex., February, 1915. Samples 7234 and 7235 were collected in the middle of the winter to show the value of such feed after it has been frozen and thawed many times, in which condition it is eaten by stock.

Sample	Moisture	Composition (water-free basis)					
		Ash	Ether extract	Crude fiber	Nitrogen-free extract	Protein	Pentosans
	Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
Department 8342 (G)	8.0	17.3	1.6	16.0	43.8	21.3	22.7
Department 7234 (W)	6.6	20.8	1.5	25.7	38.0	14.0	18.6
Department 7235 (W)	7.0	17.4	1.6	20.6	42.5	17.9	14.6
Nevada (3) and Arizona (8)	6.4	16.3	2.4	21.2	40.8	14.3	
Average	6.9	17.6	1.9	22.9	41.2	16.4	

On all parts of its area of distribution, this species is eaten freely by every kind of range stock except horses. As its leaves do not fall in winter and as it puts out leaves in the spring, whether there is any rain or not, it is valuable as a browse plant when other feed is poor. It is also an important browse plant when the smaller forage plants are covered by snow. Fleming (*5*) conducted some feeding experiments with this species. Sheep fed from 2¼ to 4¼ pounds of the green plants became sick, but those which received 4 pounds of the dried plants showed no ill effects. A yearling calf fed 2 pounds of this material showed no undesirable symptoms. At the New Mexico agricultural experiment station (*9*) a number of cows were fed on this species for several months, with satisfactory results. This station therefore recommends the plants as a source of reserve or emergency food.

ATRIPLEX CONFERTIFOLIA (Torr.) S. Wats.

Atriplex confertifolia (Pl. III, fig. 2), the shadscale of Utah and Nevada, is a rigid, much-branched bush, 1 to 2 feet high, and almost as broad. The ends of its branches are spiny, and its small, rounded or ovate leaves are crowded thick on the stems, a characteristic that has been noted in the scientific name. Like most of the saltbushes of the desert region, it is ash-gray or almost white, owing to the scurfy covering on its leaves and young stems. The expanded bracts of the fruits resemble closely the leaves, thus making the fruit hard to see. The sharp-pointed, stiff branches have given rise to the name spiny saltbush, which is occasionally used in the literature.

The species was described from material collected near Great Salt Lake, where the plant is very common. It grows on alkaline soils, along the hillsides and on the plains of the Great Basin region, from Idaho and Wyoming through Utah and Nevada, reaching California on the west, Colorado and New Mexico on the east, and parts of Arizona and northern Mexico on the south.

Department sample 8338 (G) consists of stems and leaves of the year from pistillate plants in bloom, collected near Barstow, Calif., May 29, 1906. Sample 7229 (W) consists of mature stems, leaves, and fruit, collected on the plains northeast of Lucin, Utah, September 11, 1915.

Sample	Moisture	Composition (water-free basis)					
		Ash	Ether extract	Crude fiber	Nitrogen-free extract	Protein	Pento-sans
	Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
Department 8338 (G)	9.5	30.5	1.6	33.1	25.7	9.1	14.8
Department 7229 (W)	5.6	24.8	1.2	26.1	39.0	8.9	18.6
Nevada (*3*) and Wyoming (*20*)	7.6	23.3	2.3	39.8	24.3	10.3	----
Average	7.5	25.4	1.9	34.7	28.3	9.7	----

This species is one of the most important browse plants, especially for sheep, throughout the Great Basin region. Owing to the lack of permanent watering places in the region where it grows, however, it is available only when there is snow on the ground.

ATRIPLEX ELEGANS (Moq.) Dietr.

Atriplex elegans (Pl. IV, fig. 1) is a spreading annual (sometimes perennial) herb, 6 to 18 inches high, gray-green, mealy on the under sides of the leaves and on all the young parts. The leaves are an inch long or less, and less than half as wide, with wavy or irregularly-toothed margins. Botanists distinguish it and several similar species by the peculiarities of the seed pods.

This species grows on the dry plains of western Texas, southern New Mexico, Arizona, and adjacent Mexico, where it forms a large part of the summer growth on alkaline soils occupied by annual plants only. It grows freely during the rainy season, and in southern Arizona at the lower levels it is important as a spring annual.

Department sample 11102 (G) consists of mature plants in fruit, collected near the foot of the Santa Rita Mountains, Ariz., October, 1915.

Sample	Moisture	Composition (water-free basis)					
		Ash	Ether extract	Crude fiber	Nitrogen-free extract	Protein	Pento-sans
	Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
Department 11102 (G)	6.3	10.2	1.0	48.4	30.9	9.5	20.4
Arizona (*8*) (2 samples)	6.2	22.7	2.0	20.4	40.9	1.4	----

This species is eaten readily by cattle throughout its distribution area.

ATRIPLEX FALCATA (Jones) Standl.

Atriplex falcata is a much-branched undershrub, a foot high or less, with narrowly oblong leaves, three-fourths of an inch long or less. The whole plant is densely whitish and scurfy. The small subangular seed pods, with a few coarse teeth and blunt projections on the sides, are produced in crowded panicles at the ends of the numerous slender, mostly erect stems.

Associated with shadscale and other saltbushes, this plant grows in large numbers on the plains of western Utah and adjacent Nevada.

Department sample 7230 (W), collected on the plains west of Great Salt Lake near Lucin, Utah, September 11, 1915, contained, on an air-dry basis, 5.7 per cent of moisture, and, on a water-free basis, 22.1 per cent of ash, 2 per cent of ether extract, 20.3 per cent of crude fiber, 44.6 per cent of nitrogen-free extract, 11 per cent of protein, and 18.6 per cent of pentosans.

This species forms an important part of the winter feed of the sheep visiting its area of distribution when snow is on the ground.

ATRIPLEX FASCICULATA S. Wats.[7]

Atriplex fasciculata is very similar in most respects to *A. elegans*, differing mainly in the character of the seed pods. The species is restricted, so far as known, to the desert region of southeastern California and southern Arizona. It was named from specimens collected in the Mojave Desert of California. It is common in the Salton Sink, having been described from that region under the name of *A. saltonensis*.

Department sample 8249 (G), consisting of well-grown plants in bloom and fruit, collected at Maricopa, Ariz., May 5, 1906, contained, on an air-dry basis, 4.9 per cent of moisture, and, on a water-free basis, 25.6 per cent of ash, 2.5 per cent of ether extract, 19.1 per cent of crude fiber, 39.4 per cent of nitrogen-free extract, 13.4 per cent of protein, and 14 per cent of pentosans.

ATRIPLEX HASTATA L.[8]

Atriplex hastata (Pl. IV, fig. 2) is an erect or spreading annual, 1 to 3 feet high, with mostly triangular, petioled, thickish leaves, that are generally mealy when young, becoming smooth with age. The leaves are 1 to 2½ inches long and nearly as broad, with a few coarse teeth. The seed pods are closely crowded in terminal, simple or branched, interrupted spikes. The whole plant may turn decidedly red after maturity or at the end of the season.

This species is found in saline soils or in salt marshes from Newfoundland to North Carolina, and westward in cool temperate regions to the Pacific, being common as a range plant in the northern part of the mountainous interior, especially around alkaline lakes or in water-soaked soils.

Department sample 8803 (G) consists of the whole plant in full bloom, collected at Fargo, N. Dak., August 10, 1907. Department sample 7214 (W) consists of mature plants, mostly in young fruit, collected in wet alkaline soil, 15 miles south of Laramie, Wyo., August 16, 1914.

Sample	Moisture	Composition (water-free basis)					
		Ash	Ether extract	Crude fiber	Nitrogen-free extract	Protein	Pentosans
	Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
Department 8803 (G)	9.6	14.5	1.7	28.7	44.6	10.5	18.1
Department 7214 (W)	6.1	17.2	1.5	22.3	47.9	11.1	17.8

[7] *A. elegans fasciculata* M. E. Jones; *A. elegans* Jepson; *A. saltonensis* Parish.
[8] *A. subspicata* Rydberg; *A. carnosa* A. Nelson.

As a forage plant *A. hastata* is of value only as one of the succulent weedy annuals eaten with grass or other dried feed, or by itself when dried, in the absence of better feed, by cattle and sheep. It is usually present in some quantity in prairie hay cut from the salt marshes where it grows. Cattle turned out into the fields near Salt Lake City, Utah, to clean up the forage after the crops have been taken off, browse freely on plants of this species, which grow as field weeds along fence rows and on ditch banks.

ATRIPLEX HOLOCARPA F. von Muell.

Atriplex holocarpa is one of the Australian species considered worthy of introduction into the United States. The Wyoming experiment station reported that it was a good forage crop, but not suited to the climate of that State (*19*).

The sample analyzed contained, on an air-dry basis, 5.7 per cent of moisture, and, on a moisture-free basis, 30.2 per cent of ash, 1.3 per cent of ether extract, 16.8 per cent of crude fiber, 33 per cent of nitrogen-free extract, and 18.7 per cent of protein.

ATRIPLEX JONESII Standl.[9]

Atriplex jonesii, called "quelite salada" (Pl. V, fig. 1), is a much-branched perennial, usually not more than 18 or 20 inches high. The bases of the erect stems are woody. The leaves are oblong or oval, mostly about an inch long and half an inch wide, with smooth margins, and of leathery texture. The whole plant is grayish-white, with a dense scurfy coating. The small, flat, toothed seed pods are borne in crowded panicles on the upper parts of the stems.

This plant grows fairly abundantly on the plains of northwestern New Mexico, northeastern Arizona, southwestern Colorado, and probably southeastern Utah. It will stand relatively large quantities of alkali in the soil, as well as a scanty water supply and comparatively low winter temperatures.

Department sample 11113 (G) was collected in October, 1915, on the plains along the Little Colorado River near Winslow, Ariz., the type locality of the species. Department sample 7250 (W) consists of material in full, ripe fruit, with the leaves green and succulent, although the plants had been subjected to a temperature of −11° F. only a few days before being taken. It was collected at Winslow, Ariz., January 11, 1919.

Sample	Moisture	Composition (water-free basis)					
		Ash	Ether extract	Crude fiber	Nitrogen-free extract	Protein	Pentosans
	Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
Department 11113 (G)	5.7	19.8	2.3	27.0	41.8	9.1	19.8
Department 7250 (W)	5.7	21.5	2.1	22.6	33.6	20.2	(1)

[1] Not determined.

Cattle, sheep, and goats browse on the plants of this species, which form a large part of the range feed in the area of distribution.

[9] *A. sabulosa* M. E. Jones; *A. cuneata* A. Nelson.

FIG. 1.—A SMALL BUT IMPORTANT SALTBUSH (ATRIPLEX JONESII)

It grows abundantly in the drainage basin of the Little Colorado River in northeastern Arizona

FIG. 2.—A LARGE PERENNIAL SALTBUSH (ATRIPLEX LENTIFORMIS) FROM THE SALT RIVER VALLEY, ARIZ.

Here it is sometimes called white thistle. In California it is known as quailbrush

FIG. 1.—NUTTALL'S SALTBUSH OR SALTSAGE (ATRIPLEX NUTTALLII) IN THE RED DESERT OF WYOMING

FIGS. 2 AND 3.—A PATCH OF SALTBUSH (ATRIPLEX POLYCARPA) NEAR SACATON, ARIZ., BEFORE AND AFTER CATTLE HAVE BROWSED IN IT

This saltbush is the principal forage plant throughout a large part of this region

ATRIPLEX LENTIFORMIS (Torr.) S. Wats.

Atriplex lentiformis (Pl. V, fig. 2) is a large bush, frequently 8 to 10 feet high in favorable locations, widely branching, the older stems stout and dull gray, and the younger stems slender and white scurfy, bearing numerous silvery-white, scurfy, triangular to oval leaves, 1 to 2 inches long and half as broad, on short petioles. The fruit and very small yellowish flowers are borne in large, widely branching panicles on the ends of the branches; they are produced abundantly on protected bushes. The plant rarely produces seed on the open range, where it is always closely browsed.

This plant is native in alkaline soils in southwestern Utah, western Arizona, southern California, and adjacent Mexico.

Department sample 8581 (G) consists of the ends of branches, 1 foot long or less, bearing leaves of the year, and young fruit, collected at Tempe, Ariz., September 24, 1906. Department sample 11090 (G) was collected at Point Firma, near San Pedro, Calif., October, 1915.

Sample	Moisture	Composition (water-free basis)					
		Ash	Ether extract	Crude fiber	Nitrogen-free extract	Protein	Pento-sans
	Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
Department 8581 (G)	2.7	22.3	2.1	14.6	46.0	15.0	15.84
Department 11090 (G)	7.1	24.4	1.7	15.8	40.1	18.0	10.06
Arizona (7)	6.1	5.0	2.1	28.8	55.8	8.3	----
Average	5.3	17.2	2.0	19.7	47.3	13.8	----

On the Pima Reservation in Arizona, where it is known as white thistle and has been almost exterminated by cattle, and in California, where it is known as quail brush, *A. lentiformis* is a very valuable browse plant. In both these regions efforts have been made to encourage its growth on ranches. Once established, it probably would take care of itself and spread fairly freely, if it were subjected to only a reasonable amount of grazing. In those parts of the southwestern desert region where it will grow, this species is one of the most valuable of the native saltbushes, because of its size, its rapid growth, the abundance of the forage which it produces, and particularly its palatability to livestock.

ATRIPLEX LEPTOCARPA F. von Muell.

Atriplex leptocarpa, another perennial Australian species, which grows in western Queensland, New South Wales, and South Australia, resembles the species generally known as Australian saltbush (*A. semibaccata*) in the United States. It forms a mat of vegetation, consisting of slender leafy stems that lie on the ground. The South Dakota experiment station (*26*) reported that it was valuable for the driest and most alkaline parts of that State.

The sample analyzed by the South Dakota station contained, on an air-dry basis, 7.5 per cent of moisture, and, on a water-free basis, 16.8 per cent of ash, 2.5 per cent of ether extract, 24.5 per cent of

crude fiber, 34.9 per cent of nitrogen-free extract, and 21.3 per cent of protein.

ATRIPLEX LEUCOPHYLLA (Moq.) D. Dietr.

Atriplex leucophylla is a prostrate perennial, with vinelike herbaceous stems, 1 foot to several feet in length, rising from a woody base. The young branches and the thick leaves are densely white and scurfy. The leaves are less than an inch long, elliptical, and without teeth or petioles. The flowers and fruit are produced in crowded terminal spikes.

This species grows along the sea beaches of California, from San Francisco south to Lower California, in sandy and saline soils.

Department sample 8905 (G), consisting of leafy branches, 6 to 18 inches long, with mature fruit, collected near Santa Barbara, Calif., September 13, 1907, contained, on an air-dry basis, 5.6 per cent of moisture, and, on a water-free basis, 30.3 per cent of ash, 2.5 per cent of ether extract, 18.2 per cent of crude fiber, 43.8 per cent of nitrogen-free extract, 5.2 per cent of protein, and 13.9 per cent of pentosans.

ATRIPLEX LINDLEYI Moq.

Atriplex lindleyi, another of the Australian saltbushes, is a low-growing, shrubby species, a foot or 2 feet high, from the central desert region of Australia. This plant was first tested in the California experiment station (*15*), which recommended it as one of the best of the shrubby erect Australian species for California conditions. As a result of tests at the South Dakota experiment station in 1900 (*26*), it was suggested as a possible forage plant for that part of South Dakota lying west of the Missouri River, especially on alkali soils. It was also cultivated at Laramie, Wyo. (*19*), but, although recommended as a forage plant of value, it was believed to be unsuited to the climate of Wyoming.

Sample	Moisture	Composition (water-free basis)				
		Ash	Ether extract	Crude fiber	Nitrogen-free extract	Protein
	Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
South Dakota (*26*)	6.9	17.5	3.3	25.1	33.2	20.9
Wyoming (*19*)	4.8	30.4	1.3	15.0	35.5	17.8

ATRIPLEX NUTTALLII S. Wats.

Atriplex nuttallii (Pl. VI, fig. 1) is a low, branching perennial, 1 to 2 feet high, with many erect leafy stems, rising from a woody base. The whole plant is dull gray-green; the leaves and young stems are densely scurfy. The leaves are 1½ inches long or less, half as wide, elliptical, and rather thick. The seed pods are covered with coarse projections and thick, toothed wings.

This species is widely distributed on alkaline plains and hillsides from Manitoba and Saskatchewan southward to Utah, Colorado, and western Nebraska. It is even credited to areas still farther south, probably because of incorrect identification of closely similar

species. In the literature it is usually referred to as Nuttall's saltbush, but in the Plains region it is generally called saltsage, in distinction to other gray bushes, some of which are true sagebrush.

Department sample 8831 (G), consisting of the growth of the year, in immature fruit, was collected at Havre, Mont., August 31, 1907. Department sample 7212 (W), consisting of similar material, was collected 15 miles south of Laramie, Wyo., August 16, 1914.

Sample	Moisture	Composition (water-free basis)					
		Ash	Ether extract	Crude fiber	Nitrogen-free extract	Protein	Pentosans
	Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
Department 8831 (G)	3.4	16.8	1.7	25.7	44.1	11.7	21.5
Department 7212 (W)	4.6	16.8	2.0	21.0	44.1	16.1	18.1
Wyoming (*19*) (2 samples)	5.4	14.4	1.1	24.0	45.8	14.7	----
Average	4.7	15.6	1.5	23.7	44.9	14.3	----

A. nuttallii is a valuable forage plant for cattle and sheep throughout its distribution area, in some places forming the main winter feed.

ATRIPLEX POLYCARPA (Torr.) S. Wats.[10]

Atriplex polycarpa (Pl. VI, figs. 2 and 3) is a thickly branching shrub, 2 to 4 feet high, with numerous small, scurfy, white leaves on many slender, equally scurfy, white twigs. The bark on old woody stems is gray, and old stems are rigid, sometimes ending in stiff spines. The nearly elliptical leaves, one-quarter to one-half inch long, with perfectly entire margins, are thick and crowded on the stem.

This species, known locally as desert sage, grows on alkaline soils in southern California and Nevada, ranging south into Arizona, Sonora, Mexico, and Lower California. In almost pure stands, it occupies large areas along the Gila Valley in western and southwestern Arizona, whence the species was originally described.

Department sample 8250 (G) consists of young stems and leaves of the year, collected at Maricopa, Ariz., May 5, 1906. Department sample 8585 (G) consists of leafy and fruiting branches, 4 to 6 inches long, in young fruit, collected at Tempe, Ariz., September 24, 1906.

Sample	Moisture	Composition (water-free basis)					
		Ash	Ether extract	Crude fiber	Nitrogen-free extract	Protein	Pentosans
	Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
Department 8250 (G)	5.8	25.8	2.4	15.3	38.1	18.4	13.3
Department 8585 (G)	1.8	23.3	2.3	16.1	47.4	11.2	16.8
Arizona (*8*)	5.7	14.0	2.0	31.7	38.4	13.9	----
Average	4.4	21.0	2.2	21.0	41.2	14.5	----

[10] *A. curvidens* Brandegee.

In its area of distribution in Arizona, *A. polycarpa* produces by far the greater part of the forage available for livestock. What is still more surprising, these shrubs give to a nearly grassless desert a grazing capacity nearly as hight as that of the grasslands farther north and east.

ATRIPLEX POWELLI S. Wats.[11]

Atriplex powellii is a branched annual, 2 feet high or less, with numerous oval to almost circular leaves having short petioles or none. The stems and leaves are mealy white. Its fruit, in small crowded clusters along the leafy stems, consists of small seed pods, with thickish, coarsely toothed wings, scarcely one-sixteenth of an inch wide.

The species is distributed rather widely in the alkaline soils of southwestern South Dakota, Montana, Wyoming, Utah, western Colorado, northern Arizona, and northwestern New Mexico.

Department sample 8357 (G) consists of material in bloom, collected on the plains near Winslow, Ariz., June, 1906. Department sample 10923 (G) was collected in gumbo soil at Fort Pierre, S. Dak., September 4, 1914.

Sample	Moisture	Composition (water-free basis)					
		Ash	Ether extract	Crude fiber	Nitrogen-free extract	Protein	Pento-sans
	Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
Department 8357 (G)	7.2	29.2	1.9	15.7	37.6	15.6	23.7
Department 10923 (G)	4.8	24.9	1.5	25.4	35.8	12.4	19.3

Evidently *A. powellii* is not a very important stock food. It is used by livestock only when forced to it by lack of something better or by a general scarcity of feed.

ATRIPLEX ROSEA L.[12]

Atriplex rosea is an erect, vigorously growing, branching, leafy annual, gray-green or sometimes a little yellowish, and mealy on all young parts and on the lower sides of even the older leaves. The leaves are 2 inches long or less, about half as broad, oval to oblong in outline, with a few coarse teeth on each side, acute at the top, and tapering to the base. Although an introduction from Europe, this species is widely distributed in cultivated fields in the Eastern States and on many waste lands in the cooler parts of the range country of the Western States.

Department sample 8883 (G) consists of material in early fruit, collected at Dalles, Oreg., August 22, 1907. Department sample 7206 (W) consists of material in full flower, including more than half of the stems and leaves of 3-foot plants, collected at Craig, Colo., August 5, 1914.

[11] *A. philonitra* A. Nelson; *A. nelsoni* M. E. Jones.
[12] *A. spatiosa* A. Nelson.

Sample	Moisture	Composition (water-free basis)					
		Ash	Ether extract	Crude fiber	Nitrogen-free extract	Protein	Pento-sans
	Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
Department 8883 (G)	4.1	13.3	1.7	27.0	47.2	10.8	17.9
Department 7206 (W)	4.8	13.3	1.3	28.1	48.1	9.2	20.6

A. rosea, although not a dominant plant over extended areas, is eaten by both cattle and sheep wherever it grows. Fleming (*5*) conducted feeding experiments with this species. A yearling calf fed 12¼ pounds showed no ill effects; a sheep receiving 1 pound a day for six days lost 7 pounds in weight, although it had free access to alfalfa all the time; a second sheep fed 1 pound was slightly sick; and a third sheep fed 2 pounds died. These results indicate that certain saltbushes are sometimes poisonous to sheep.

ATRIPLEX SEMIBACCATA R. Br.[13]

Atriplex semibaccata is the plant usually referred to in the literature in the United States (*8*, *12*, *14*, *15*, *17*, *19*, *23*, *26*) as the Australian saltbush, although several Australian species of the genus Atriplex have been tried at different places. Just where the vernacular name originated has not been learned. To call this plant a saltbush is very misleading, in the ordinary meaning of the word bush, as it is not a shrub. Even its roots are perennial only in the warmer parts of the semiarid West. Its stems are slender, prostrate, vine-like, and herbaceous, making a thick matlike rosette, from 18 inches to several feet in diameter, depending upon the conditions under which it is grown.

After thorough tests in the California experiment station, it was extensively introduced into parts of California. It has been tried with more or less success in a number of western States. It has escaped from cultivation rather sparingly in southern California, Arizona, and New Mexico, but it is not very aggressive. The exhaustive tests to which it has been subjected show it to be suited to a warm, dry climate, a medium amount of water, and an alkaline soil. In such places it may be expected to put a medium to heavy crop of fairly good forage on land that otherwise would be almost valueless, the size of the crop depending largely upon the amount of water available.

Department sample 9646 (G) consists of the succulent growth of the year, not yet in fruit, collected on the hills back of San Diego, Calif., April 1, 1909. Department sample 7035 (W) consists of plants not yet in fruit, growing vigorously, collected at East Bakersfield, Calif., where they had escaped from cultivation, March 18, 1912.

[13] *A. flagellaris* Wooton and Standley.

Sample	Moisture	Composition (water-free basis)					
		Ash	Ether extract	Crude fiber	Nitrogen-free extract	Protein	Pentosans
	Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
Department 9646 (G)	5.8	10.5	2.5	17.3	49.3	20.4	12.4
Department 7035 (W)	10.4	20.1	2.7	14.3	42.3	20.6	12.8
Experiment stations (14 samples)	7.2	18.8	1.7	23.6	40.4	15.5	----------
Average	7.3	18.4	1.8	22.6	41.1	16.1	----------

A. semibaccata is for the most part a cultivated crop wherever it is of any importance, so that it can not be classed among the native forage plants. Reports from Australia credit the quality of the wool produced there in part to the saltbush eaten by the sheep.

ATRIPLEX THORNBERI (Jones) Standl.

Atriplex thornberi is a low, branching annual, similar in most respects to *A. elegans* and *A. fasciculata*, and growing in much the same area. This species is known as yet only from the low, hot, and dry plains of southern Arizona, although it probably extends into southern California and northern Mexico.

Department sample 8572 (G), consisting of mature fruiting plants, from which the seed had begun to fall, collected at Phœnix, Ariz., September 24, 1906, contained, on an air-dry basis, 1.4 per cent of moisture, and, on a water-free basis, 17.8 per cent of ash, 2.2 per cent of ether extract, 22.6 per cent of crude fiber, 46.2 per cent of nitrogen-free extract, 11.2 per cent of protein, and 17.3 per cent of pentosans.

A. thornberi is one of the annuals which doubtless could be used most seasons to obtain a crop of usable forage from land that otherwise would produce nothing.

ATRIPLEX TRIDENTATA Kuntze [14]

Atriplex tridentata is a low perennial, very similar in general appearance to Nuttall's saltbush or the saltsage of the Red Desert region of south-central Wyoming. It is usually a little larger, being 10 inches to 2 feet high, with longer and narrower leaves, and generally not so yellowish, looking almost white when young, from the thick, white, scurfy covering on leaves and stems. The leaves are longer (often 2 inches) and mostly narrower, sometimes not more than one-sixteenth of an inch wide, and the bracts of the abundant fruit are different. Otherwise it resembles the saltsage and goes without distinction under that name in Wyoming.

It is known only from the plains of southern Wyoming, northwestern Colorado, and northeastern Utah.

Department sample 7220 (W), consisting of the growth of a year, with the stems in full leaf and nearly mature fruit, collected at Rawlins, Wyo., August 17, 1914, contained, on an air-dry basis, 4.4 per cent of moisture, and, on a water-free basis, 21.9 per cent of

[14] *A. pabularis* A. Nelson.

ash, 1.9 per cent of ether extract, 20.2 per cent of crude fiber, 40.2 per cent of nitrogen-free extract, 15.8 per cent of protein, and 17.6 per cent of pentosans.

ATRIPLEX TRUNCATA (Torr.) A. Gray

Atriplex truncata (Pl. VII, fig. 1) is an erect, branched annual herb, from a few inches to more than 3 feet high, usually about a foot. The leaves are oval to triangular, some of the upper ones being heart-shaped and clasping the stem. The whole plant is gray-green, owing to a mealy or scurfy coating, which makes it look gray. The small fruits are borne in abundance in crowded clusters along the branches, especially toward the tips.

The species was described from material collected in Nevada, which is near the middle of its distribution area. It grows freely on alkaline soils from British Columbia and eastern Washington to Wyoming and Colorado and south to California and northwestern New Mexico, abounding on the open plains and also as a roadside and vacant lot weed in the towns of that region.

Department sample 7211 (W), consisting of complete leafy stems heavily loaded with half mature fruit, collected at Laramie, Wyo., August 14, 1914, contained, on an air-dry basis, 4.4 per cent of moisture, and, on a water-free basis, 22.4 per cent of ash, 1.6 per cent of ether extract, 21.5 per cent of crude fiber, 39.3 per cent of nitrogen-free extract, 15.2 per cent of protein, and 16.6 per cent of pentosans.

A. truncata is eaten by cattle and sheep, just as are many of its near allies in the same region.

ATRIPLEX WRIGHTII S. Wats.

Atriplex wrightii is an erect, spreading annual, 1 to 3 feet high, with stout angled stems and numerous leaves, which are mealy when young but become smooth as they get old. The leaves are sometimes 3 but usually 2 inches long or less, narrowly oblong or oval, tapering at the base but not petioled, and with several coarse, sharp teeth. The staminate flowers, dull yellow and crowded in terminal spikelike clusters, and the pistillate flowers, in small clusters among the leaves, are borne on the same plant. The fruits are numerous and small, with two-toothed bracts.

The species grows in alkaline soil in southern California, western and southern Nevada, southern and western Arizona, and adjacent Mexico. Seed is produced in large quantities.

Department sample 8587 (G), consisting of material in full fruit, collected on the Santa Cruz bottoms near Tucson, Ariz., September 25, 1906, contained, on an air-dry basis, 2.9 per cent of moisture, and, on a water-free basis, 15.2 per cent of ash, 2.4 per cent of ether extract, 28.8 per cent of crude fiber, 42.1 per cent of nitrogen-free extract, 11.5 per cent of protein, and 17.8 per cent of pentosans.

On flats receiving one or two floodings in a season, large quantities of forage might be produced by *A. wrightii*, as well as by several other annual species of this genus and other genera of this family. Such hay if properly cared for would be valuable in winter.

BETA VULGARIS L.

The sugar beet is a member of the same botanical family as the saltbushes. Sugar beets, grown in many parts of the United States and cultivated on irrigated lands in certain parts of the arid region, produce as a by-product forage in the form of the tops, which are cut off the plants when the crop is gathered.

A few of the chemical analyses of sugar-beet forage made by the agricultural experiment stations are recorded here.

Sample	Moisture	Composition (water-free basis)				
		Ash	Ether extract	Crude fiber	Nitrogen-free extract	Protein
	Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
Indiana (*30*)	88.8	25.3	5.4	22.4	22.3	24.6
Kansas (*4*)	87.9	16.2	2.0	8.8	53.5	19.5
Nevada (*29*)	88.0	19.0	3.9	8.4	63.2	5.5
Do	88.9	21.7	3.6	8.6	47.7	18.4
Do	88.7	[1] 17.7	1.9	8.5	51.4	20.5
California (*16*)	87.1	5.4	.3	11.9	67.5	14.9
Average	88.2	17.6	2.9	11.4	50.9	17.2

Beet tops, consisting of a bunch of large leaves and a small part of the beet, are eaten freely by both cattle and sheep. In the arid region it is not uncommon to sell the beet tops to owners of range stock. The tops dry more or less, but the stock eat them dry or green.

CHENOPODIUM ALBUM L.

Lamb's-quarter, a well-known annual garden and field weed throughout the United States, originally introduced from Europe, is one of about 50 species of a genus of herbaceous plants that have been given a name derived from the Greek, meaning "goosefoot," because of the shape of the leaves of certain species. The species *album* is sometimes called pigweed, and in the Southwest quelite, because of its wide use as greens.

Lamb's-quarter is widely scattered over the western grazing lands, especially where the native plants have been eaten or tramped out, in places where a moderate amount of rain falls during the growing season. In the northern part of the Great Plains and Great Basin area or in mountain parks or valleys in the Southwestern States, wherever the ground is denuded, this weed usually appears. Once introduced, its seed habits are such that nothing but vigorous perennials will drive it out. Its adaptation to the life of a weed in cultivated ground and its abundant production of small seeds have been important factors in its spread.

Department sample 10907 (G) consists of a whole plant in early maturity, with a mass of seed, cut close to the ground, near Green River, Wyo., September 1, 1914.

FIG. 1.—AN ANNUAL SALTBUSH (ATRIPLEX TRUNCATA) AS CULTIVATED IN OREGON

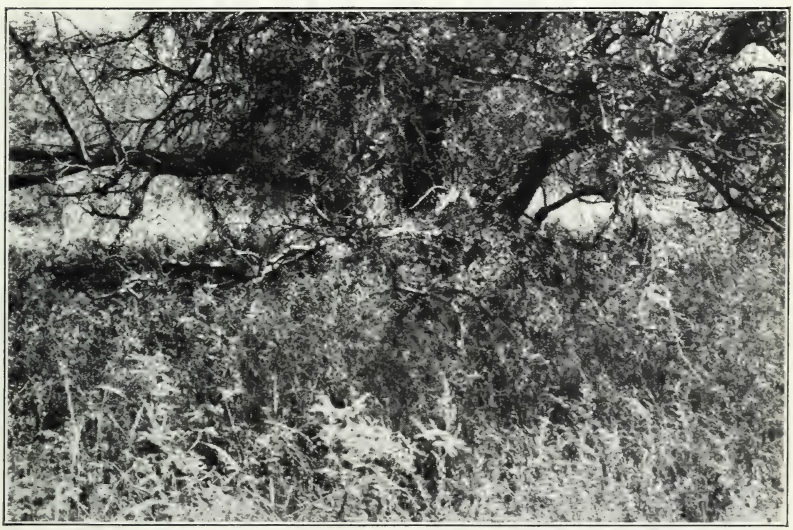

FIG. 2.—CHENOPODIUM ARIZONICUM GROWING UNDER A MESQUITE NEAR THE SANTA RITA MOUNTAINS IN SOUTHERN ARIZONA

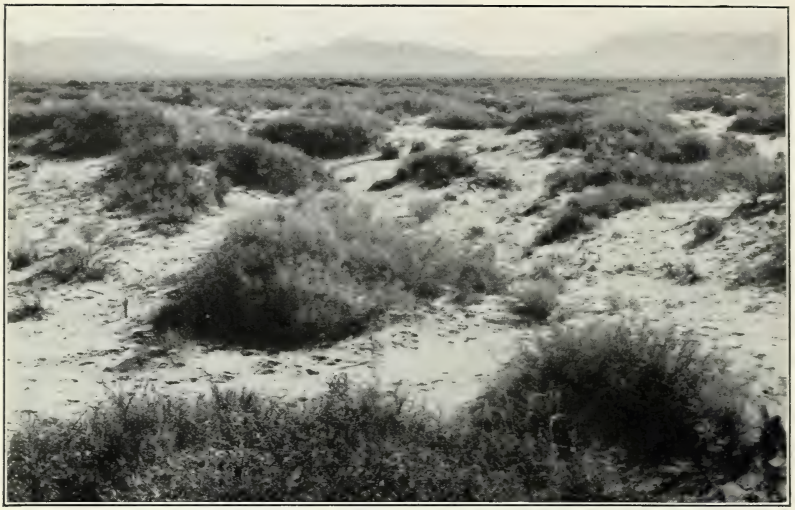

FIG. 1.—CHENOPODIUM CYCLOIDES, C. PRATERICOLA, AND C. NEOMEXICANUM GROWING UNDER THE PROTECTION OF LOW MESQUITE BUSHES ON SAND DUNES IN SOUTHERN NEW MEXICO

This vegetation provides forage over large areas in this region

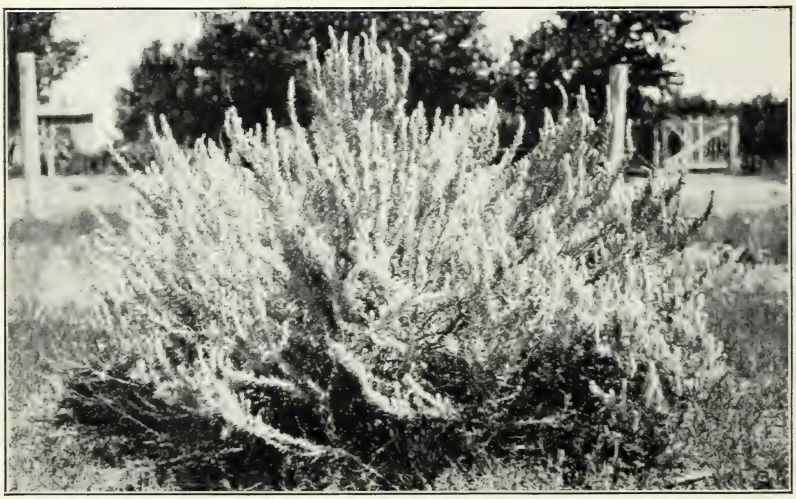

FIG. 2.—A MATURE WELL-GROWN PLANT OF WHITE SAGE (EUROTIA LANATA), KNOWN ALSO AS WINTER FAT

Sample	Moisture	Composition (water-free basis)					
		Ash	Ether extract	Crude fiber	Nitrogen-free extract	Protein	Pentosans
	Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
Department 10907 (G)	5.4	15.9	4.3	23.7	42.9	13.2	12.0
Massachusetts (*28*)	80.8	15.8	3.9	13.3	46.4	20.6	----------

As a range plant, lamb's-quarter is eaten freely by sheep and cattle. Apparently it is a very good feed.

CHENOPODIUM ARIZONICUM Standl.

Chenopodium arizonicum (Pl. VII, fig. 2) grows to be 2 feet high or more under favorable conditions. Its leaves are pale or dark-green above and scurfy beneath. Its slender, widely spreading branches bear an abundance of fruit. Like all other species of this genus, it accommodates its size to the water supply. In seasons or places of scanty water supply the plants are small and dry up soon, but they usually produce some seed. This species is one of several closely related species of annual herbs that grow in the mountains, foothills, and outwash plains in the southwestern United States. So far as is now known from collections, it grows only in southern Arizona. It is, however, very similar in appearance to other species that have a much wider distribution. This species prefers the slight shelter afforded by scattering mesquites or other shrubs and trees.

Department sample 7217 (W), consisting of mature plants in full leaf and fruit, collected under a low mesquite tree on the Santa Rita Range Reserve, Pima County, Ariz., at an elevation of 4,000 feet, September 9, 1914, contained, on an air-dry basis, 5.2 per cent of moisture, and, on a water-free basis, 12.5 per cent of ash, 2.8 per cent of ether extract, 31.1 per cent of crude fiber, 42.7 per cent of nitrogen-free extract, 10.9 per cent of protein, and 12.6 per cent of pentosans.

Like the rest of the species closely related to it, *C. arizonicum* is important as range forage. When produced abundantly, horses do not eat the plants while green, probably because of the abundance of better feed. The absence of well-grown plants on the open cattle range, however, indicates that cattle eat them freely during the growing season.

CHENOPODIUM CYCLOIDES A. Nels.

Chenopodium cycloides (Pl. VIII, fig. 1) is a native annual herb, often reaching a height of 3½ to 4 feet. It branches freely, producing erect slender stems, that bear narrow green leaves, an inch or so long, and many flat, discoid reddish or brownish-black seeds, to which the calyx remains attached like a little membranous wing. This seed structure is eminently suited to the drifting sands where these plants grow. It grows in the drifting sand dunes about the bases of the low mesquite and other bushes on the ranges of southern New Mexico, where it is sometimes abundant. It is also known from similar regions in western Kansas.

Department sample 7219 (W), consisting of plants in full seed, cut just above the ground, before the leaves had begun to dry, on the Jornada Range Reserve, some 45 miles northeast of Las Cruces, N. Mex., at an altitude of about 4,300 feet, October 14, 1914, contained, on an air-dry basis, 4.2 per cent of moisture, and, on a water-free basis, 13.4 per cent of ash, 2.2 per cent of ether extract, 27.9 per cent of crude fiber, 43 per cent of nitrogen-free extract, 13.5 per cent of protein, and 16.5 per cent of pentosans.

Cattle eat the plant freely, along with other similar species that grow with it, especially after it is mature and covered with seed.

CHENOPODIUM INCANUM (S. Wats.) Heller

Chenopodium incanum is an ash-gray annual herb of spreading habit, sometimes 18 inches high, but usually lower. It has the general mealiness common to the genus, developed to a greater degree than in most other species, which gives the peculiar gray color. When young and growing vigorously, the broadly triangular leaves are rather thick and have a cool or clammy feel.

This plant grows freely on the dry plains and hillsides of the semiarid Southwest, from western Nebraska, Kansas, and Texas, westward to Utah, New Mexico, and Arizona, southward into northern Mexico. It requires less water than the other species of this genus so far mentioned, and will also endure relatively large quantities of alkali in the soil.

Department sample 7198 (W), consisting of plants in flower, cut just above the ground, on the Jornada Range Reserve, about 35 miles north of Las Cruces, N. Mex., at an elevation of about 4,100 feet, May 31, 1914, contained, on an air-dry basis, 3.8 per cent of moisture, and, on a water-free basis, 27.4 per cent of ash, 1.8 per cent of ether extract, 16.9 per cent of crude fiber, 32.8 per cent of nitrogen-free extract, 21.1 per cent of protein, and 12.3 per cent of pentosans.

Cattle and sheep eat it freely, along with the grasses and other herbage common where it grows. As a species adapted to places in which many other forage plants are at a disadvantage, this species is important.

CHENOPODIUM PRATERICOLA Rydb.

Chenopodium pratericola (Pl. VIII, fig. 1) is an annual, with greenish, mostly erect stems that turn reddish in the fall. Its leaves are undivided, 1 to 2 inches long, and a fourth as wide. It is only slightly mealy on the younger parts. It produces an abundance of seeds.

This is one of the several closely-related species of goosefoot that are widely distributed in the Western States, from Saskatchewan to northern Mexico, and from the Pacific eastward to Missouri. It grows in dry or sandy soils, or in the cultivated areas as a waste-ground or fence-corner weed. It rarely if ever forms a complete stand over any large area, but grows under the protection of low shrubs.

Both department samples consist of plants in full leaf, with ripe seeds. Sample 7207 (W) was collected on the sagebrush land, above irrigation level, at an elevation of about 6,200 feet, at Craig,

Colo., August 5, 1914. Sample 7218 (W) was collected under mesquite bushes on sandy soil on the Jornada Range Reserve, at an elevation of about 4,300 feet, about 45 miles northeast of Las Cruces, N. Mex., October 14, 1914.

Sample	Moisture	Composition (water-free basis)					
		Ash	Ether extract	Crude fiber	Nitrogen-free extract	Protein	Pentosans
	Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
Department 7207 (W)	4.9	16.7	1.8	22.7	45.0	13.8	14.2
Department 7218 (W)	4.0	13.8	2.4	35.9	35.5	12.4	17.5

C. pratericola is eaten freely by cattle, especially after the seeds are mature. Like most other species of this genus, it is a stock food of some importance in the range country, but a nuisance on cultivated lands. Several species that are valuable as forage plants in the range country are really weeds introduced from Europe, which can endure the conditions of the semiarid West.

CHENOPODIUM SALINUM Standl.

Chenopodium salinum is a spreading annual, a foot to 18 inches high, with numerous branching stems that give it the form of a tumbleweed. The leaves are 1½ inches long or less, about half as wide, pale-green above and mealy-white beneath, with a few coarse teeth along the sides. The flowers are small, green, and densely crowded in clusters toward the ends of the stems. The reddish-brown, slightly tuberculate seeds are usually produced in abundance.

The species is found in alkaline soils from Manitoba and Alberta southward to Arizona and New Mexico. Like several of its near relatives, it can occupy land bare of vegetation, because it is well adapted to such locations within its distribution area.

Department sample 8806 (G), consisting of plants cut just above the ground, when the seeds were in the early stage of maturity, at Fargo, N. Dak., August 10, 1907, contained, on an air-dry basis, 8.9 per cent of moisture, and, on a water-free basis, 14.5 per cent of ash, 3.6 per cent of ether extract, 21.8 per cent of crude fiber, 49.2 per cent of nitrogen-free extract, 10.9 per cent of protein, and 12.3 per cent of pentosans.

DONDIA DEPRESSA (Pursh) Britton [15]

Dondia depressa (Pl. IX, fig. 1) is an annual herb, with succulent leaves and stems, sometimes growing erect to a height of a foot or two and sometimes spreading weakly. Under certain conditions the plant turns a rather bright red as it reaches maturity, making a conspicuous spot of color beside the alkaline lakes and in the salty sinks where it usually grows. (Pl. I, fig. 2.) It produces quantities of seed.

In the botanical textbooks the common name seablight or saltwort (*13*) is applied to the plants of this genus, but the writers have

[15] *Suaeda erecta* var *depressa*.

never heard any vernacular name used in this connection. About 20 species of the genus are widely distributed on alkaline soils. This species, originally described from the volcanic plains of the upper Missouri River region, grows from Washington, Saskatchewan, and Minnesota to California, Nevada, New Mexico, and western Texas.

Department sample 8820 (G), consisting of plants 12 to 15 inches high, in very early bloom, was collected at Devils Lake, N. Dak., August 11, 1907. Department sample 7213 (W), consisting of plants about 18 inches high, in flower, was collected beside an alkaline lake 15 miles south of Laramie, Wyo., August 16, 1914.

Sample	Moisture	Composition (water-free basis)					
		Ash	Ether extract	Crude fiber	Nitrogen-free extract	Protein	Pento-sans
	Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
Department 8820 (G)	9.5	19.5	1.7	22.1	47.6	9.1	20.6
Department 7213 (W)	5.4	27.7	2.5	22.9	38.8	8.1	16.3

It is doubtless not a very valuable stock food, and is eaten, mixed with dry grass or browse, only when better feed is gone.

DONDIA FRUTICOSA (L.) Druce [16]

Dondia fruticosa is a low shrub, with white stems and small, cylindrical, succulent leaves, an inch long or less. The young stems also are succulent. Like *D. depressa*, it is an alkali-loving plant, and grows only in soils that are too alkaline for most other plants, commonly in soil that is water-soaked at least part of the time. It is found in alkaline flats, beside pools or springs, or along streams where alkali has accumulated, usually associated with some of the saltbushes. Because of their restriction to strongly alkaline soils, such plants are common in widely separated regions. Thus this species is reported in all the Western States, from Alberta to northern Mexico. Over small areas it is locally sometimes very important.

Department sample 8580 (G), consisting of about 6 inches of tips of branches, including all the growth of the year and part of that of the previous year, in bloom and fruit, was collected at Tempe, Ariz., September 24, 1906. Department sample 10909 (G), consisting of material having fully ripe seed, was collected at Green River, Wyo., September 1, 1914.

Sample	Moisture	Composition (water-free basis)					
		Ash	Ether extract	Crude fiber	Nitrogen-free extract	Protein	Pento-sans
	Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
Department 8580 (G)	1.1	35.8	2.7	13.1	33.6	14.8	12.5
Department 10909 (G)	3.8	35.2	5.1	15.1	30.4	14.2	12.1

D. fruticosa is browsed by cattle, sheep, and goats.

[16] *D. intermedia* Heller; *Suaeda intermedia* S. Watson.

DONDIA SUFFRUTESCENS (S. Wats.) Heller [17]

Dondia suffrutescens is a plant from 2 to 3 feet high, with succulent leaves and young stems, woody at the base. It resembles *D. fruticosa* very closely, except that it is often dull red.

It grows in alkaline soils in southern New Mexico, western Texas, and adjacent Mexico. It is also fairly abundant on gypsum soil. The Mexicans often call it *yerba del burro*, possibly confusing it with the burro-weed (Allenrolfea) of that region, but probably giving it that name because it is freely eaten by burros.

Department sample 7233 (W), consisting of the more succulent parts of fruit-laden leafy branches, collected near State College, N. Mex., October 22, 1915, contained, on an air-dry basis, 5.7 per cent of moisture, and, on a water-free basis, 30.7 per cent of ash, 1.3 per cent of ether extract, 25 per cent of crude fiber, 28.2 per cent of nitrogen-free extract, 14.8 per cent of protein, and 11.6 per cent of pentosans.

Livestock eat this species fairly freely where other feed is poor, which is the case throughout much of its distribution area.

ENDOLEPIS DIOICA (Nutt.) Standl.

Endolepis dioica is a small plant, closely related to and in many ways resembling several of the annual saltbushes (Atriplex spp.). It is a much-branched, gray annual herb, with small leaves crowded on the stems. Its flowers are inconspicuous, and the flower clusters are covered with fine cobwebby hairs. It produces seed freely.

It was named from material collected near Fort Mandan, N. Dak., and its distribution is from the western Dakotas into Wyoming and Montana. It is usually one of the first plants to take possession of the denuded gumbo soils of the Dakota region. It prefers alkaline soil.

Department sample 10924 (G), collected on washed gumbo soil at Fort Pierre, S. Dak., September 4, 1914, contained, on an air-dry basis, 3.6 per cent of moisture, and, on a water-free basis, 45.9 per cent of ash, 1.8 per cent of ether extract, 11.3 per cent of crude fiber, 29.3 per cent of nitrogen-free extract, 11.7 per cent of protein, and 10 per cent of pentosans.

E. dioica is an important forage plant for sheep and cattle on the partially denuded alkaline soils of its area of distribution. The readiness with which it takes possession of bare soil makes it important in the revegetation of overgrazed lands.

EUROTIA LANATA (Pursh) Moq.

Eurotia lanata is a perennial, 1 or 2 feet high, with many erect stems in a cluster, woody at the base only. (Pl. VIII, fig. 2.) Its leaves are small and narrow. The whole plant is ash-gray, being covered with a thick coat of short white hairs. The flowers are small and inconspicuous, but the seeds are borne in clusters of white, hairy, one-seeded pods at the ends of the stems. These silky-white seed pods give rise to the name white sage.

This species grows rather abundantly on plains and hillsides from Washington and Saskatchewan to western North Dakota and south

[17] *Suaeda suffrutescens* S. Watson.

to the mountains of western Texas, New Mexico, Arizona, and California. On the northern plains it is called white sage, probably because of its general superficial resemblance to other sagebrush of that region, although it does not have a strong aromatic odor. Sheepmen in the southern part of its distribution area call it winter fat. It rarely grows in pure stands over large areas, but is widely scattered (Pl. II, fig. 2), being more common in cooler places.

Department sample 8599 (G), the growth of the year, about 9 to 12 inches of the stem-carrying leaves and the nearly ripe fruit, was collected at Deming, N. Mex., September 29, 1906. Department sample 9714 (G), consisting of stems, leaves, and fruit after it had been frosted, when it is said to be good stock food, was collected near Williams, Ariz., November, 1908.

Sample	Moisture	Composition (water-free basis)					
		Ash	Ether extract	Crude fiber	Nitrogen-free extract	Protein	Pento-sans
	Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
Department 8599 (G)	2.7	7.9	2.4	31.2	45.4	13.1	16.2
Department 8714 (G)	3.9	4.1	3.7	27.7	52.0	12.5	16.6
Colorado (*1*) and Wyoming (*19, 21*) (4 samples)	8.1	8.9	2.5	29.9	44.2	14.5	----------
Average	6.5	7.9	2.7	29.8	45.7	13.9	----------

E. lanata is recognized by stockmen throughout the range country as a very valuable feed. The fact that it is always browsed closely wherever livestock can get at it shows that cattle, sheep, and goats like it. In the southern part of its distribution area it is highly valued by sheepmen as a winter stock food. It is an excellent range forage plant, and its growth should be encouraged whenever possible. In one place in north central Arizona it is coming in freely on overstocked short-grass range, showing unexpected characteristics which may prove important.

GRAYIA SPINOSA (Hook.) Moq.

Grayia spinosa (Pl. IX, fig. 2) is a low, branched shrub, 1 to 3 feet high, with stiff, grayish branches that are often spiny. It is very hairy when young. The slightly fleshy leaves are 1½ inches long or less, half as wide at the top, tapering below, and soft-hairy on both sides when young. The fruit is a whitish or reddish pod, nearly circular, one-fourth to half an inch in diameter, and surrounded by a narrow wing. The shrub is common in alkaline soils throughout the Great Basin region.

A sample analyzed at the Nevada experiment station (*3*) contained, on an air-dry basis, 7.9 per cent of moisture, and, on a water-free basis, 10.9 per cent of ash, 4.5 per cent of ether extract, 13.8 per cent of crude fiber, 50.6 per cent of nitrogen-free extract, and 20.2 per cent of protein.

G. spinosa is an important forage plant on the ranges of its area of distribution.

FIG. 1.—DONDIA DEPRESSA PLANTS IN FULL FRUIT, UNDER CULTIVATION IN OREGON

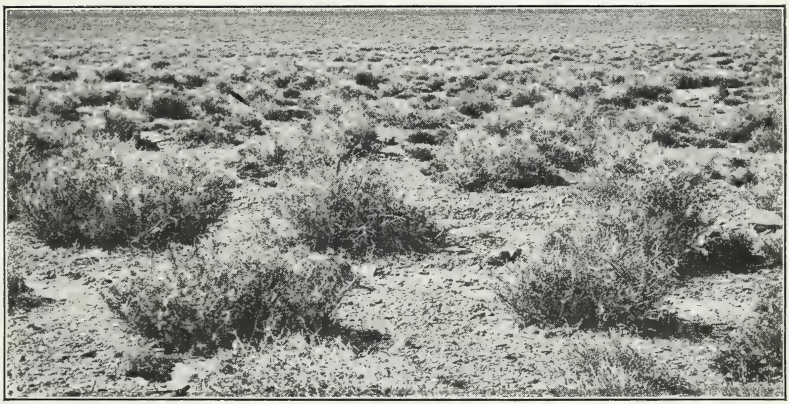

FIG. 2.—SPINY SALTBUSH (GRAYIA SPINOSA) IN THE INYO VALLEY, CALIF.

FIG. 3.—A TYPICAL GROWTH OF GREASEWOOD (SARCOBATUS VERMICULATUS) NEAR WINNEMUCCA, NEV.

FIG. 1.—CARELESS WEED (AMARANTHUS PALMERI) IN SOUTHERN ARIZONA
This land has been well watered by the natural run-off of summer showers

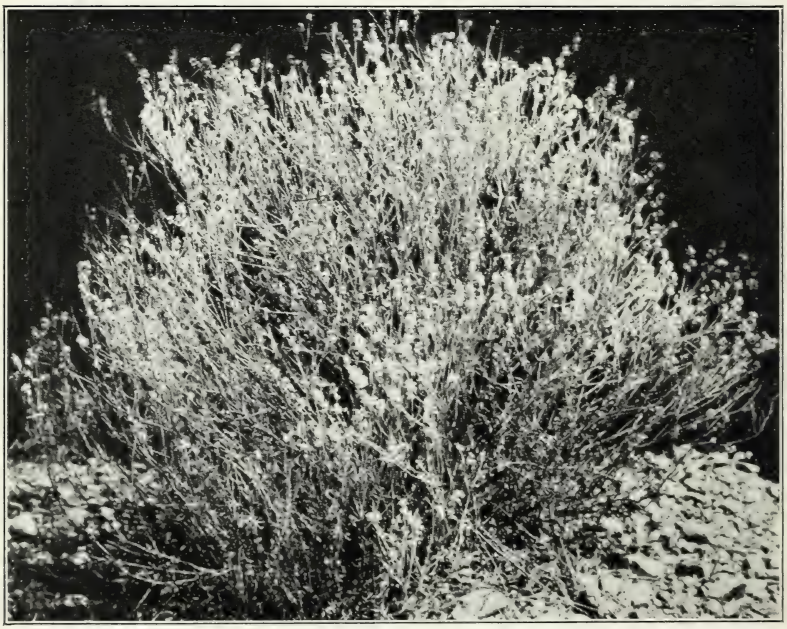

FIG. 2.—A WELL-GROWN PLANT, ABOUT 2 FEET HIGH AND IN FULL BLOOM, OF ERIOGONUM WRIGHTII FROM SOUTHERN ARIZONA

KOCHIA AMERICANA S. Wats.

Kochia americana is a low, succulent plant, from 5 inches to 2 feet high, with clustered stems, woody only at the base. Its leaves are small, simple, and cylindrical, and, like the young stems, succulent. At first the plant is slightly hairy, but it soon becomes smooth. It grows in the alkaline soils of the Great Basin region, where it is known as red sage.

Department sample 10764 (G), collected at Green River, Wyo., August, 1912, contained, on an air-dry basis, 4.7 per cent of moisture, and, on a water-free basis, 22.4 per cent of ash, 1.9 per cent of ether extract, 14.1 per cent of crude fiber, 45.5 per cent of nitrogen-free extract, 16.1 per cent of protein, and 12.7 per cent of pentosans.

K. americana is important only as one of the few species that can live and produce edible forage upon the alkaline soils of its area of distribution. In the Red Desert region of Wyoming and in the slick deserts of Nevada it grows locally in abundance, supplying winter feed for sheep.

KOCHIA SCOPARIA (L.) Schrad.

Kochia scoparia, an annual weed introduced from Europe, is becoming naturalized in many places in the United States, particularly in the Western States. It appears mainly as a waste-ground weed in towns and on roadsides, but seems able also to compete for a place on the range. It may be expected to continue to take possession of denuded lands wherever the seeds are scattered, as far as other plants will permit.

Department sample 10910 (G), consisting of the main leafy branches of large plants in late blossom, collected at Green River, Wyo., September 1, 1914, contained, on an air-dry basis, 4.4 per cent of moisture, and, on a water-free basis, 14.5 per cent of ash, 1.8 per cent of ether extract, 23.7 per cent of crude fiber, 37.4 per cent of nitrogen-free extract, 22.6 per cent of protein, and 16.4 per cent of pentosans.

The value of *K. scoparia* as a forage plant depends upon its associates wherever it enters the range country. Present indications are that it will always be of less than first rank in importance.

KOCHIA VESTITA (S. Wats.) Rydb.

Kochia vestita is a low, much-branched, gray plant, with many erect or spreading stems, rarely reaching the height of 1 foot. The bases of the stems are woody; the young parts are succulent. The leaves are cylindrical and slightly fleshy, one-fourth to half an inch long, and about one-sixteenth of an inch in diameter. All the young parts are covered with a scanty growth of short, appressed white hairs, which give the plant a grayish-green color. The flowers and fruit are small and inconspicuous. The fruit has a narrow, dark, winglike border.

K. vestita grows rather abundantly on the less alkaline plains of the Great Basin region, extending from western Colorado into Nevada.

Department sample 7231 (W), consisting of plants in full fruit, collected on the plains west of Great Salt Lake, near Lucin, Utah,

September 11, 1915, contained, on an air-dry basis, 5.3 per cent of moisture, and, on a water-free basis, 22.1 per cent of ash, 3.6 per cent of ether extract, 16.2 per cent of crude fiber, 41.1 per cent of nitrogen-free extract, 17 per cent of protein, and 13 per cent of pentosans.

K. vestita is one of the alkali-resistant desert plants that form the winter feed of the migratory bands of sheep visiting the Great Basin region when snow is on the ground.

SALSOLA PESTIFER A. Nels.

The Russian thistle (*Salsola pestifer*) is an introduced tumbleweed, bearing no resemblance and having no close botanical relationship to the plants commonly known as thistles. It is an annual weed that has spread widely over the waste lands of the arid and semiarid West, where it has become a pest in nearly all the towns and on the farms, particularly on fallow lands.

FIG. 1.—Stack of Russian thistle hay near Wheatland, Wyo. Another cutting, surrounding the stack, is about ready for the mower

Department sample 8360 (G) consists of plants in full bloom and beginning to get prickly, collected at Winslow, Ariz., June 1, 1906. Department sample 9321 (G) consists of young and tender stems, 8 to 10 inches long, in full bloom, collected at Canon City, Tex., June 28, 1908.

Sample	Moisture	Composition (water-free basis)					
		Ash	Ether extract	Crude fiber	Nitrogen-free extract	Protein	Pentosans
	Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
Department 8360 (G)	6.4	28.4	1.8	14.1	36.3	19.4	8.7
Department 9321 (G)	5.3	26.0	1.6	14.5	41.1	16.8	9.6
Colorado (*12*) and Iowa (*22*) (12 samples)	60.5	20.1	2.1	22.6	41.0	14.2	----
Average	52.7	21.1	2.0	21.4	40.7	14.8	----

Although the country would be much better off without it, the Russian thistle has some use as forage. While young, before the stems and leaves get stiff, sheep and cattle eat it freely, and do as well on it as on other forage plants. In the dry-farming areas

it will take possession of fields when the planted crop has not had enough water to make it grow. Under such conditions the Russian thistle has been the only crop taken off the ground in many places (fig. 1). If cut at the right stage, livestock eat it freely in the winter as hay, when it is much better than nothing. It has also been made into silage. It remains to be seen whether the native grasses in the Great Plains region can displace Russian thistle from land that has been plowed and then allowed to go back to its original condition.

SARCOBATUS VERMICULATUS (Hook.) Torr.

Sarcobatus vermiculatus (Pl. IX, fig. 3) is the well-known greasewood of the Great Basin region. The true greasewood is a shrub, usually 4 to 8 feet high, but often 10 feet high or more when growing as single bushes in favorable places. The rigid stems are whitish, with papery bark on the younger branches, which grow nearly at right angles to the main stems and almost always end in a sharp point. The leaves are an inch long or less and cylindrical, usually about one-sixteenth of an inch in diameter, succulent, pale yellowish-green, and smooth. The pale color of the stems and leaves and the lack of odor of the plant at once distinguish it from the creosote bush, to which the name greasewood is applied from western Texas across southern New Mexico and Arizona to California. The creosote bush is dark brownish-green, with black stems, and two-part resinous leaves.

Greasewood grows only on alkaline soils. In New Mexico and Arizona, where it is sometimes called chico, it is usually found at levels of 5,500 feet or more. In the Great Basin region it often occupies large areas where the soil is alkaline.

Department sample 8355 (G) consists of plants in early bloom, the growth of the year, which had been so closely grazed that it was hard to get enough for a sample, collected along the river bottoms at Winslow, Ariz., June, 1906. Department sample 8583 (G) consists of 6-inch tips of branches, possibly including some growth of previous years, collected at Tempe, Ariz., September 24, 1906.

Sample	Moisture	Composition (water-free basis)					
		Ash	Ether extract	Crude fiber	Nitrogen-free extract	Protein	Pentosans
	Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
Department 8355 (G)	6.2	17.4	1.7	15.9	42.4	22.6	14.4
Department 8583 (G)	6.7	21.0	3.5	16.0	38.9	20.6	13.3
Arizona (8)	4.6	15.1	2.6	25.6	35.9	20.8	----------
Average	5.8	17.8	2.6	19.2	39.1	21.3	----------

S. vermiculatus constitutes the greater part of the stock food in its distribution area on the alkaline soil in the Great Basin region. Sheep and cattle eat the succulent young branches and leaves freely, although it is said that sheep suffer from bloat if they are allowed too free access to the plants at certain stages of growth.

PIGWEED FAMILY

ACANTHOCHITON WRIGHTII Torr.

Acanthochiton wrightii is a weedlike annual, native to the sandy lands of western Texas, New Mexico, Arizona, and adjacent Mexico. It resembles the careless weeds or pigweeds (Amaranthus spp.) of that region in general appearance, but differs in the structure of the flower parts and in the fruit. It is an erect, branching, pale-green herb with narrowly oblong leaves, 2 inches long or less and less than one-fourth as wide, having wavy, crisped margins and prominent pale veins. The flowers are of two kinds, borne on different plants in long, slender, crowded terminal spikes. The fruits are surrounded by pale green, leaflike, spiny bracts, one fourth of an inch long or less. The seed habits of this species are good, and the plants are well adapted to the severe conditions of their habitat.

Department sample 7072 (W), consisting of mature fruiting plants, from which part of the old leaves had fallen, collected on the plains in sandy soil, about 25 miles north of Las Cruces, N. Mex., September 21, 1912, contained, on an air-dry basis, 6.5 per cent of moisture, and, on a water-free basis, 12.3 per cent of ash, 1.7 per cent of ether extract, 37.7 per cent of crude fiber, 42.4 per cent of nitrogen-free extract, 5.9 per cent of protein, and 16 per cent of pentosans.

While green, these plants are eaten freely by range stock, with every evidence that they are palatable.

AMARANTHUS PALMERI S. Wats.

Under favorable conditions, *Amaranthus palmeri* grows to a height of 6 or 7 feet and branches widely, producing an abundance of small glossy black seeds, which retain their viability for a long time. (Pl. X, fig. 1.) Under unfavorable conditions, the plants may grow to a height of only a few inches, in most cases, however, producing viable seeds. This species may be recognized by the long, slender, drooping spikes of greenish staminate flowers.

The distribution area of this species is on the lower, drier, and warmer plains from California eastward to western Kansas and Texas, and southward into Mexico. It is one of the most common of the pigweeds of the Southwest, where it is known also as careless weed and not infrequently as quelite. It is a common weed on irrigated land, where it nearly always grows on ditch banks along the roads and in most cultivated fields. It also grows freely on range lands, especially on land which receives some irrigation from a local run-off each season. It is most commonly found in arroyos or in small drainage basins that receive some flood waters.

Department sample 8570 (G), consisting of the lower branches in full leaf and flower, collected at Phoenix, Ariz., September 24, 1906, contained, on an air-dry basis, 2.7 per cent of moisture, and, on a water-free basis, 12.8 per cent of ash, 1.8 per cent of ether extract, 33.3 per cent of crude fiber, 41.1 per cent of nitrogen-free extract, 11 per cent of protein, and 16 per cent of pentosans.

In certain places in southern Arizona the Mexicans harvest an occasional volunteer crop of *A. palmeri*, which makes a coarse hay.

This suggests the possibility of growing it as a hay crop in that region. The green plants, wherever they grow, are eaten freely by all kinds of range stock. The possibilities of usefulness of this plant have been appreciated by only a few people as yet.

FROELICHIA FLORIDANA (Nutt.) Moq.

Froelichia floridana is a tall, slender herb, known locally as cotton-head, which grows in the Southeastern States.

A sample analyzed in the Florida experiment station (*24*) contained, on an air-dry basis, 10.8 per cent of moisture, and, on a water-free basis, 5.7 per cent of ash, 2.2 per cent of ether extract, 36.5 per cent of crude fiber, 51.2 per cent of nitrogen-free extract, and 4.4 per cent of protein.

The Florida experiment station (*24*) reports that this species is eaten by livestock in the Southeastern States. Other very nearly related species growing as scattered plants on the hillsides and mesas of the arid Southwestern States are eaten freely by livestock. They are not usually very abundant in any place, but the total quantity of forage they produce is large and seems to be appreciated by range livestock.

GOMPHRENA SONORAE Torr.

Gomphrena sonorae is an erect, branching annual that grows to a height of 2 feet or less, depending on the quantity of water it gets. Its stems are pale yellow or reddish. Its leaves are 1 to 2 inches long and about one-fourth as wide, oblong, yellowish-green, and softly hairy. Its flowers suggest pink and white varieties of the cultivated bachelor button. The fruits are covered with white cottony hairs.

This species grows in some abundance on the foothills and plains beyond the mountains of southern Arizona and California and adjacent Mexico. It rarely makes pure stands.

Department sample 8945 (G), consisting of mature leafy plants in full fruit, cut just above the ground in the foothills of the Santa Rita Mountains of southern Arizona, September 24, 1907, contained, on an air-dry basis, 6.5 per cent of moisture, and, on a water-free basis, 8 per cent of ash, 2 per cent of ether extract, 33.2 per cent of crude fiber, 50.6 per cent of nitrogen-free extract, 6.2 per cent of protein, and 19.1 per cent of pentosans.

G. sonorae helps to make up the summer forage of the region where it grows. Its absence on the open range, as compared with its abundance on protected ranges, shows that livestock eat it freely during the growing season.

TIDESTROMIA LANUGINOSA (Nutt.) Standl.[18]

Tidestromia lanuginosa is a low, spreading annual, 4 to 6 inches high and 18 inches to 3 feet across. It is ashy white and densely covered with white stellate hairs that disappear from the older stems, which turn dull reddish. The leaves are an inch long or less and half as wide, rounded above and tapering below. The flowers are very small and the fruit is equally inconspicuous.

[18] *Cladothrix lanuginosa* Nuttall.

The plant grows on the drier soils of the plains from South Dakota to Kansas and Texas and westward to Colorado, Utah, New Mexico, and Arizona, extending into northern Mexico.

Department sample 7085 (W), consisting of mature plants in full leaf, cut just above the ground, on sandy soil about 25 miles north of Las Cruces, N. Mex., contained, on an air-dry basis, 4.5 per cent of moisture, and, on a water-free basis, 14.6 per cent of ash, 1.6 per cent of ether extract, 26.9 per cent of crude fiber, 44 per cent of nitrogen-free extract, 12.9 per cent of protein, and 19.5 per cent of pentosans.

While young and green, these plants are eaten freely by cattle and sheep, and even the old dried plants are eaten in seasons of scanty feed. The ability to endure unfavorable climatic conditions and produce forage of even a poor quality where nothing better will grow is the most important economic characteristic of the species.

BUCKWHEAT FAMILY

ERIOGONUM ABERTIANUM Torr.

Eriogonum abertianum is a small herbaceous annual, which varies in height from an inch to 6 or 8 inches, with many slender stems and small leaves. It is always covered with dense clusters of small bright-yellow flowers, variegated with scarlet. It grows on the plains of western Texas and New Mexico to Arizona and adjacent Mexico, especially on sandy soils, forming a large part of the plant growth of that region.

Department sample 7074 (W), consisting of plants in full leaf and flowers, collected on sandy soil about 25 miles north of Las Cruces, N. Mex., September 21, 1912, contained, on an air-dry basis, 6.5 per cent of moisture, and, on a water-free basis, 12.8 per cent of ash, 1.9 per cent of ether extract, 19.8 per cent of crude fiber, 57 per cent of nitrogen-free extract, 8.5 per cent of protein, and 11.5 per cent of pentosans.

Wherever it grows, *E. abertianum* is eaten freely by cattle and sheep. It is one of the many annuals that are used by livestock, along with the grasses of the area of its distribution.

ERIOGONUM ANNUUM Nutt.

Eriogonum annuum is a slender annual, from 1 to 3 feet high, leafy near the ground, sometimes branched, often with a single erect stem, terminating in a flat-topped cluster of pale whitish or pinkish flowers that do not fall off but turn rusty as the seeds mature. The whole plant is covered with a mat of soft woolly hairs, and the basal leaves dry and shrivel as the seeds mature. The species is found all over the Great Plains country from North Dakota to Texas and westward to Montana and Arizona. It seeds freely and will grow on a small supply of water, seeming to prefer sandy soil.

Department sample 7186 (W), collected on the plains about 25 miles north of Las Cruces, N. Mex., October 14, 1913, contained, on an air-dry basis, 5.2 per cent of moisture, and, on a water-free basis, 5.7 per cent of ash, 2 per cent of ether extract, 26.7 per cent of crude fiber, 57.6 per cent of nitrogen-free extract, 8 per cent of protein, and 12.6 per cent of pentosans.

Where it is best adapted to the conditions, this species puts a tolerably heavy crop of forage on the ground. Cattle eat it freely, especially after the seeds are mature.

ERIOGONUM EFFUSUM Nutt.

Eriogonum effusum is a low, diffusely spreading, herbaceous perennial, that sends up a number of branching green stems, 6 to 12 inches high, the lower parts being woody. The leaves are small and are attached to the lower parts of the stems, which are dark brownish-red where the white woolly coating is rubbed off. The whole rounded top of the plant is covered with small whitish flowers, each of which is not more than one-sixteenth of an inch long, but they are so numerous that the whole plant looks white. Like the flowers of most of the species in the genus, they persist and turn rusty after the seeds mature. This species and several other similar species grow freely on the plains east of the Rockies in Colorado, Wyoming, and Nebraska, and in the northern part of the Great Basin region.

Department sample 7216 (W), consisting of mature plants, with some of the basal leaves dry and the fruit young, collected at Wheatland, Wyo., August 24, 1914, contained, on an air-dry basis, 6.2 per cent of moisture, and, on a water-free basis, 3.9 per cent of ash, 2.4 per cent of ether extract, 23.4 per cent of crude fiber, 61.4 per cent of nitrogen-free extract, 8.9 per cent of protein, and 11.7 per cent of pentosans.

E. effusum is grazed freely by livestock wherever it grows and adds to the feed produced each year on the ranges of its area of distribution.

ERIOGONUM FASCICULATUM Benth.

Eriogonum fasciculatum is a low, branching shrub, 2 feet high or less, and about as broad. The older stems are bright reddish-brown, with stringy grayish old bark; the younger stems are almost white. The leaves are one-fourth to half an inch long, and thickish, with the margins rolled under; they are borne in crowded clusters at short distances along the younger stems. The small, bright pink flowers are borne in headlike clusters at the ends of peduncles, 3 to 5 inches long.

E. fasciculatum grows on the drier, hotter mountains of southwestern Arizona and southeastern California, extending into northern Sonora and Lower California.

Department sample 7016 (W), consisting of young leafy stems with flowers, collected on rocky hills near Congress Junction, Ariz., February 18, 1912, contained, on an air-dry basis, 9 per cent of moisture, and, on a water-free basis, 5.8 per cent of ash, 1.6 per cent of ether extract, 21.6 per cent of crude fiber, 64.2 per cent of nitrogen-free extract, 6.8 per cent of protein, and 10.5 per cent of pentosans.

E. fasciculatum is an important early spring feed for sheep, particularly when the growth of herbaceous annuals is scanty. These plants make some growth whether there is rain enough for the annuals or not. Conditions unfavorable to the growth of the weedy annuals are very hard on range sheep, and any edible species that can produce feed for them at such a time is of particular value.

ERIOGONUM HEERMANNI Dur. and Hilg.

Eriogonum heermanni is a leafy shrub, 1½ to 2 feet high, with repeatedly branched, short panicles of rose-colored or yellowish flowers. The leaves are at first white and woolly, later becoming smooth, about half an inch long, and petioled. The panicle is spinescent and smooth. This species grows in the Mojave Desert region, ranging northward to the Sierra Nevada and into Nevada, where it is common.

A sample analyzed in the Nevada experiment station (*3*) contained, on an air-dry basis, 6.7 per cent of moisture, and, on a water-free basis, 7.3 per cent of ash, 7.7 per cent of ether extract, 24.6 per cent of crude fiber, 49.9 per cent of nitrogen-free extract, and 10.5 per cent of protein.

ERIOGONUM MICROTHECUM Nutt.

Eriogonum microthecum is a low, widely branched, woody shrub, generally less than a foot high. The bark on older stems is shreddy and gray, stripping off readily to expose the reddish-brown younger layers. The younger stems are covered with fine, matted, white hairs that rub off easily. The leaves are elliptic-oblong, without marginal teeth, densely white hairy beneath, sparingly so above, generally not over half an inch long. The small white flowers, which change to pink with age, are very numerous and are borne in widely branched clusters. This plant is common on the nut-pine, cedar, and sagebrush-covered hills of central Utah.

Department sample 7232 (W), consisting of the growing ends of the branches bearing green leaves, flowers, and some young fruit, collected near Tintic, Utah, September 13, 1915, contained, on an air-dry basis, 6.3 per cent of moisture, and, on a water-free basis, 7.2 per cent of ash, 1.6 per cent of ether extract, 21.3 per cent of crude fiber, 60.7 per cent of nitrogen-free extract, 9.2 per cent of protein, and 10.9 per cent of pentosans.

This species is eaten freely by livestock in its area of distribution.

ERIOGONUM PINETORUM Greene

Eriogonum pinetorum, a summer annual, varies greatly in size, depending upon the amount of water it receives. In dry seasons it may be only 2 to 4 inches high and still produce seed. In favorable conditions it is often 18 inches and sometimes more than 2 feet high and much branched. Its leaves may be 2 inches long and half as broad, with an oval outline, or they may be reduced to narrow bractlike outgrowths. The flowers are small but numerous, in small heads, forming parts of a much-branched inflorescence. They are pale pink at first, turning rusty, and are persistent. The species grows in western Texas, New Mexico, Utah, Arizona, and adjacent Mexico.

Department sample 8953 (G), consisting of mature plants in full flower, with the lower leaves drying, collected in the foothills of the Santa Rita Mountains, contained, on an air-dry basis, 5.5 per cent of moisture, and, on a water-free basis, 6.5 per cent of ash, 2.1 per cent of ether extract, 23.9 per cent of crude fiber, 59.8 per cent of nitrogen-free extract, 7.7 per cent of protein, and 13.1 per cent of pentosans.

E. pinetorum forms part of the food for cattle and sheep on the plains and foothills of the Southwest.

ERIOGONUM POLYCLADON Benth.

Eriogonum polycladon differs from *E. pinetorum* chiefly in the shape and size of the leaves and flowers and the general woolliness of the plant. Casual observers would hardly notice the difference, although it is conspicuous enough when pointed out. The two species are similar in chemical composition. *E. polycladon* grows over the same areas and serves the same purpose as *E. pinetorum*.

Department sample 8944 (G), consisting of mature plants in full bloom, cut near the ground in the foothills of the Santa Rita Mountains, contained, on an air-dry basis, 6.1 per cent of moisture, and, on a water-free basis, 5.6 per cent of ash, 2.4 per cent of ether extract, 30.1 per cent of crude fiber, 53.9 per cent of nitrogen-free extract, 8 per cent of protein, and 12.1 per cent of pentosans.

ERIOGONUM WRIGHTII Torr.

Eriogonum wrightii is a branching shrub, 2 feet high or less, with woody, reddish-brown basal stems, from which the white woolly covering is usually worn off. The upper stems are densely woolly, grayish-white, and much branched. (Pl. X, fig. 2.) The leaves, most of which are on the older stems, are small and white-woolly, like the young stems. The species grows rather freely on rocky hillsides and in rough canyons in the foothills of the mountains in Arizona, New Mexico, and western Texas, and southward into Mexico.

Department sample 8593 (G) consists of material in full bloom, with the leaves dry, collected in the Santa Rita Mountains, Ariz., September 27, 1906. Department sample 8943 (G) consists of the growth of the year in full leaf and flower, collected in the Santa Rita Mountains, Ariz., September 23, 1907.

Sample	Moisture	Composition (water-free basis)					
		Ash	Ether extract	Crude fiber	Nitrogen-free extract	Protein	Pentosans
	Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
Department 8593 (G)	3.5	3.4	2.1	30.5	57.1	6.9	15.1
Department 8943 (G)	6.0	3.9	2.5	27.5	58.6	7.5	12.5

The little shrubs begin to grow in the spring, probably from stored moisture, the stimulus to growth apparently being the rise in temperature. For this reason, they are an important stock food at a time when other feed may be and often is scanty. Cattle and sheep eat the young shoots with relish. It is therefore much appreciated by cattlemen on some ranges in southern New Mexico, although they have given it no common name.

FAGOPYRUM ESCULENTUM Moench

Buckwheat (*Fagopyrum esculentum*) (*27*) is included here merely because of its botanical relationship to the wild species of the same plant family, some of which are valuable forage plants in the range country.

The average composition of four samples analyzed in several agricultural experiment stations was, moisture, 21.6 per cent, and, on a water-free basis, 11.8 per cent of ash, 2.6 per cent of ether extract, 26 per cent of crude fiber, 46.2 per cent of nitrogen-free extract, and 13.4 per cent of protein. The average composition of five samples of straw analyzed in several agricultural experiment stations was, moisture, 10 per cent, and, on a water-free basis, 6 per cent of ash, 1.5 per cent of ether extract, 48.4 per cent of crude fiber, 38.7 per cent of nitrogen-free extract, and 5.4 per cent of protein.

POLYGONUM AVICULARE L.

Polygonum aviculare is a prostrate wiry-stemmed annual weed, with branching green stems, 6 to 12 inches long, and small leaves. One of the knotweeds, it is a common dooryard and wayside weed, introduced from Europe and scattered widely all over the United States.

A sample analyzed in the South Dakota experiment station (*25*) contained, on an air-dry basis, 6.9 per cent of moisture, and, on a water-free basis, 5.9 per cent of ash, 2.9 per cent of ether extract, 20.3 per cent of crude fiber, 52.1 per cent of nitrogen-free extract, and 18.8 per cent of protein.

On the range, *P. aviculare* forms part of the summer forage crop.

POLYGONUM ERECTUM L.

Polygonum erectum is an annual weed, with slender green stems, similar to *P. aviculare*, but erect and spreading, 1 to 2 feet high. The leaves are small, and the flowers are very inconspicuous. It is another of the knotweeds that grow on the western plains.

A sample analyzed in the South Dakota experiment station (*25*) contained, on an air-dry basis, 9.8 per cent of moisture, and, on a water-free basis, 6.6 per cent of ash, 1.8 per cent of ether extract, 32.1 per cent of crude fiber, 48.1 per cent of nitrogen-free extract, and 11.4 per cent of protein.

POLYGONUM RAMOSSISSIMUM Michx.

Polygonum ramossissimum is a widely branching, green-stemmed annual, ordinarily from 6 inches to 1 foot high, but in favorable soils reaching a height of more than 3 feet. The stems are slender and tough, with frayed brownish scales at the joints. The leaves are an inch long or less and about one-third as broad. The small white flowers are borne with the leaves. The fruit is a triangular one-seeded pod, something like a buckwheat "seed." Ordinarily a wayside or garden weed, this species grows in sandy soils all over the United States except in the far northeastern and the most southern States.

Department sample 8805 (G) consists of material in early fruit with some leaves fallen, collected at Fargo, N. Dak., August 10, 1907.

Sample	Moisture	Composition (water-free basis)					
		Ash	Ether extract	Crude fiber	Nitrogen-free extract	Protein	Pentosans
	Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
Department 8805 (G)	9.6	9.4	3.8	24.9	50.0	11.9	17.6
South Dakota (*26*)	8.4	7.4	1.9	30.2	45.0	15.5	----------

On sandy loam in the semiarid Plains region this species forms a part of the summer growth which is eaten by livestock. It also constitutes a small part of the prairie hay cut in these areas.

RUMEX BERLANDIERI Meisn.

Rumex berlandieri, known as Mexican dock in southern California, is a succulent thick-stemmed herbaceous perennial, 2 to 3 feet high, with leaves 3 to 6 inches long and one-fourth to one-sixth as wide, having a long taproot. The flowers and fruit are borne in a terminal panicle, usually several inches long. The species grows in southwestern Texas, southern Arizona, and California, in the Colorado Desert country, and extends southward into Mexico. It grows mostly in "tight" soils that receive more water than the normal rainfall of such regions, and it will endure a great deal of alkali. In flooded basins, beside alkali lakes and along streams and ditches, this plant is fairly common, and in a few places it is moderately abundant.

Department sample 9099 (G), consisting of plants in early bloom, cut 3 inches above the ground at Phoenix, Ariz., March 21, 1908, contained, on an air-dry basis, 3.1 per cent of moisture, and, on a water-free basis, 13.8 per cent of ash, 2.9 per cent of ether extract, 15.2 per cent of crude fiber, 42.1 per cent of nitrogen-free extract, 26 per cent of protein, and 8.3 per cent of pentosans.

Whenever it is accessible, livestock eat *R. berlandieri* freely.

RUMEX HYMENOSEPALUS Torr.

Rumex hymenosepalus, a perennial dock generally known as canaigre, has large leaves and tuberous roots that are somewhat like sweet potatoes in shape and size. It grows freely on the sandy plains of southern Arizona, New Mexico, and western Texas, beginning its growth in the mild winter weather, blooming in spring and early summer, and drying up in midsummer. Its thickened roots are a source of tannin.

The begasse from the extracted roots analyzed in the Arizona experiment station (*6*) contained, on a water-free basis, 2.3 per cent of ash, 0.7 per cent of ether extract, 12.1 per cent of crude fiber, 77 per cent of nitrogen-free extract, and 7.9 per cent of protein.

Forbes states that he has seen animals eat the flower stalks. They doubtless eat both the young green and the old dried leaves in times of scarcity.

RUMEX MEXICANUS Meisn.

Rumex mexicanus, one of the commonest of the docks of the Great Plains and Rocky Mountain region, is a stout, branching herb, with one or more erect stems, 18 inches to 3 feet high, rising from a perennial root. There is frequently a cluster of leaves about the base of the stem and leaves are scattered along the stem. The leaves are simple, generally 4 to 8 inches long and about an inch wide, smooth, and pale green. The numerous small, pale-yellow or greenish flowers are borne in a panicle at the end of the stem. The triangular fruits, which follow the flowers, are at first green, but later dry and brown, the seeds being inclosed in the slightly enlarged sepals, each of which bears a calloused swelling on the back. Although these plants prefer moist soil, they endure much drouth and much alkali. They rarely, if ever, grow as pure stands over large areas, but are scattered with other plants.

Department sample 8798 (G), consisting of the upper parts of leafy and fruit-bearing stems above the dead basal leaves, with the seeds mostly ripe, collected at Fargo, N. Dak., August 10, 1907, contained, on an air-dry basis, 7.5 per cent of moisture, and, on a water-free basis, 6 per cent of ash, 1.8 per cent of ether extract, 24.4 per cent of crude fiber, 57.9 per cent of nitrogen-free extract, 9.9 per cent of protein, and 9.4 per cent of pentosans.

The succulent stems and leaves are relished by livestock, and the seeds are a valuable feed.

COMMON NAMES AND THEIR SCIENTIFIC EQUIVALENTS

COMMON NAME	SCIENTIFIC NAME
Australian saltbush	*Atriplex holocarpa.* *Atriplex lindleyi.* *Atriplex semibaccata.*
Beet tops	*Beta vulgaris.*
Buckwheat	*Fagopyrum esculentum.*
Burro-weed	*Allenrolfea occidentalis.*
Bushy samphire	*Allenrolfea occidentalis.*
Canaigre	*Rumex hymenosepalus.*
Careless weed	*Amaranthus palmeri.*
Chamese Chamizo Coarse sage	*Atriplex canescens.*
Cottonhead	*Froelichia floridana.*
Desert sage	*Atriplex polycarpa.*
Dock	Rumex (any species).
Goosefoot	Chenopodium (any species).
Greasewood	*Sarcobatus vermiculatus.*
Iodine-weed	*Allenrolfea occidentalis.*
Knotweed	Polygonum (certain species).
Lamb's-quarter	*Chenopodium album.*
Mexican dock	*Rumex berlandieri.*
Nuttall's saltbush	*Atriplex nuttallii.*
Pickle-weed	*Allenrolfea occidentalis.*
Pigweed	Amaranthus (certain species).
Quail brush	*Atriplex lentiformis.*
Quelite	*Chenopodium album.*
Quelite salada	*Atriplex jonesii.*
Red sage	*Kochia americana.*
Russian thistle Russian tumbleweed	*Salsola pestifer.*
Saltbush	Atriplex (any species).
Saltsage	*Atriplex nuttallii.*
Seablight	*Dondia suffrutescens.*
Shadscale	*Atriplex confertifolia.*
Spiny saltbush	*Grayia spinosa.*
Sugar beet tops	*Beta vulgaris.*
White sage	*Eurotia lanata.*
White thistle	*Atriplex lentiformis.*
Winter fat	*Eurotia lanata.*
Yerba del burro	*Dondia suffrutescens.*

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